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# Applying Cooperative Learning to the New York State Living Environment Curriculum

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Applying Cooperative Learning to the New York State Living Environment Curriculum

By

James Reed Franklin

December 19, 2014

A culminating project submitted to the Department of Education and Human Development of  
The College at Brockport, State University of New York in partial fulfillment of the  
requirements for the degree of Master of Science in Education

Applying Cooperative Learning to the New York State Living Environment Curriculum

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### **Abstract**

According to the National Education Association, students need to be prepared to be contributing members in global society (2012). Therefore, students need to learn how to collaborate and communicate with peers in a group. So far, competition has been prevalent in the academics of the United States (Shindler, 2009). Cooperative learning provides a teaching approach based on group success.

Furthermore, there is a plethora of benefits from the use of cooperative learning in the science classroom. It promotes psychological health and high academic achievement (Johnson, Johnson & Roseth, 2010; Mesch, Johnson and Johnson, 2001). Cooperative learning is also a good approach for student centered learning. When students are able to effectively engage and interact with each other, they can learn from and teach each other with minimal assistance from the teacher. In a country where inclusive education is being pushed, it is important to have strategies that work for diverse learners. Cooperative learning works well for a variety of learners (Jones & Sterling, 2011; Lin, 2006).

There are five components which must be present in a lesson for it to be considered cooperative learning. These components are positive interdependence, promotive interaction, individual accountability, interpersonal skills, and group processing. These components are used to ensure genuine cooperation between students (Johnson, Johnson & Houlbec, 1994).

This project consists of 10 lesson plans that apply cooperative learning to the New York State Living Environment course. Each lesson is based on concepts from the NYS Living Environment Core Curriculum, but they also incorporate cooperative learning to facilitate a deep understanding of the concepts.

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## **Chapter I: Introduction**

### **Rationale**

Teaching for all learners is an important issue as diversity is being promoted in the classroom. Educators cannot expect all of their students to conform to one style of learning. We need to give students opportunities to learn in their own way. Therefore, teachers need to create ‘student centered’ classrooms. Students should have control over how they learn the content. While it would be difficult for the teacher to differentiate the instruction for each student, it would be more logical to have the students help each other. When peers work together, they can have more control over their lessons, and learn in their own way. One special type of peer learning is known as cooperative learning.

Cooperative learning is an appropriate teaching approach if the goal is for all students to develop deep understanding of the content. Cooperative strategies work for all learners (Jones & Sterling, 2011; Lin, 2006). According to Johnson et al. (1994), cooperative learning involves students working together to achieve outcomes that are not only beneficial to themselves, but beneficial to the entire group. If even one student is falling behind, the rest of the group cannot progress. Cooperative learning provides ways for students to present material to each other. It provides diverse teaching for diverse learners. By helping each other, students are able to understand the concepts more clearly for themselves.

Johnson, Johnson & Houlbec (1994) suggested three major approaches a teacher can utilize when facilitating instruction to a group of students. One is to promote competition among students by encouraging everyone to make an effort to be the best in the class. Another way is to have students work independently, and learn at their own pace. A third approach is to have

students work together in small groups where all must achieve certain goals. For classes of diverse learners, cooperative learning seems to be the most suitable approach.

Cooperative learning can also be used to help promote the idea that science is a social construction. In other words scientific knowledge is built by a community of researchers. Some individuals get credit for making significant discoveries or conclusions in science. However, even if the individuals worked alone, they depended on research from other scientists. Scientists not only have to know how to cooperate with others in research and investigations, but they also need to know how to communicate their findings to the scientific community. So, the knowledge acquired through science is not absolute truth. It is what the majority of researchers agree is true based on empirical evidence.

Richard and Bader (2010) claim that adolescent students have a naïve concept of what science is. Most students see science as an objective subject with one right explanation for every phenomenon. Students should see that, for many topics in science, there are various views among the most highly accredited experts. This should encourage students to see science as an area where they can contribute their own ideas and views rather than mindlessly conform to what the experts claim. When science is taught in a class where students work together, and are encouraged to share their ideas, students can see scientific concepts in a more subjective way and gain deeper understanding of the topics.

This project will apply cooperative learning to the New York state regents living environment course by creating lesson plans that incorporate all five of the components of cooperative learning. By incorporating cooperative learning techniques, students of all different learning levels should achieve a sound understanding of the major concepts in the living environment course. These lesson plans will be written so that any science teacher, who wants to



promote cooperative learning in their classroom, can comprehend and use them in their classrooms.

### **Significance of Project**

Teachers focus mainly on individual achievement when planning out the curriculum. There is usually a minority of students who fall behind by not achieving the objectives of the lessons. Cooperative learning is a unique approach to teaching that promotes all students to succeed. Incorporating the five components of cooperative learning should ensure that no student fails to achieve the goals of each lesson. In a society that has been dominated by individualism and competitiveness, true cooperation is somewhat of a foreign idea. However, the ability to work within groups is becoming important for success in a global society. According to the National Education Association (NEA), students are going to need to develop skills in collaboration and cooperation if they are to be successful contributors to society (2012). Cooperation is a skill that is not commonly taught or demonstrated through the education system. Lessons like those in this project can help steer students away from competition, and help them realize the benefits from successful social interactions.

By working together in science, students can learn to view science as an endeavor that groups rather than individuals participate in. Each person has something to contribute in science, but must also rely on others to progress. There will be some form of positive interdependence in each of the lessons of this project so that students can learn to depend on each other to achieve success. There will also be some aspect of individual accountability in each lesson, so that each student will contribute to the group the best they can. Cooperative learning does not work if one student does all the work for the group. Students will also learn valuable social skills by

participating in the cooperative activities in these lessons. To be successful in the group activities, the students will have to learn how to communicate, and resolve conflicts in a respectful way. It will be a learning process, especially for students who are not used to social interactions. This is why it is important to incorporate the group processing component into the lessons. Group processing will also allow each student to discover their own strengths, as well as the strengths of their peers. Overall, students will learn that, at least in science, they do not have to do everything by themselves.

### **Overview of the following chapters**

Chapter II contains a review of the research on cooperative learning. It explains why cooperative learning should be used in the classroom. The review also synthesizes the information on the theoretical background that has been used in the development of cooperative learning. After that, the review thoroughly describes each of the five components of cooperative learning and how they can be used. Then there is a summary on the implementation along with scaffolding and assessment for cooperative lessons.

Chapter III contains a collection of cooperative learning lesson plans. These lesson plans cover many of the concepts in the New York State Living Environment core curriculum. Using these lessons should result in deeper understanding of the content as well as the development of important collaboration and communication skills.

### **Definition of Terms**

COOPERATIVE LEARNING: Two or more students work together to achieve a common goal.

INTERPERSONAL SKILLS: Ability to interact with other people in a positive and respectful way.

SOCIAL CONSTRUCTIVISM: The theory that humans construct knowledge based on interactions with other people.

ZONE OF PROXIMAL DEVELOPMENT: The potential level of understanding a student can reach, in a certain topic, with the assistance of a teacher or peer.

POSITIVE INTERDEPENDENCE: The belief that an individual will not achieve his/her goals unless one or more other individuals achieve their goals.

NEGATIVE INTERDEPENDENCE: The belief that an individual will not achieve his/her goals unless one or more other individuals fail to achieve their goals.

POSITIVE GOAL INTERDEPENDENCE: Form of positive interdependence where individuals must depend on each other to achieve a goal.

POSITIVE RESOURCE INTERDEPENDENCE: Form of positive interdependence where individuals must depend on each other to have all the necessary resources to complete a task.

POSITIVE REWARD INTERDEPENDENCE: Form of positive interdependence where individuals must depend on each other to earn a reward.

PROMOTIVE INTERACTION: The act of individuals encouraging each other to succeed.

INDIVIDUAL ACCOUNTABILITY: The idea that each individual in a group is responsible to do his/her part and full participate in a group activity.

GROUP PROCESSING: The act of a group of individuals reviewing what they did well and what they could have done better.

## **Chapter II: Literature Review**

### **Overview**

Schools, in the United States, contain a great variety of students. Students in many classrooms display a diversity of ethnicities, cultures, learning styles and languages to name a few. One learning style is not going to work for every student. Since it is extremely challenging for a teacher to cater to each individual student's learning style, students need to be able to help themselves and each other through the content. When students work together in small groups they are free to learn in their own way. An effective type of group learning is known as cooperative learning.

Cooperative learning is a well established and researched teaching approach. It works well for a class of diverse learners (Jones & Sterling, 2011; Lin, 2006). Cooperative learning allows students to achieve outcomes that are a benefit to the entire group as well as to each individual (Johnson, Johnson & Houlbec, 1994). With cooperative learning, students can help teach content to their peers, and in so doing gain a deeper understanding of the content themselves.

Cooperative learning can also give students the opportunity to practice science collaboratively. Scientific knowledge is built by a community of researchers. Scientists have to be able to cooperate with each other during research, and also communicate their findings to the scientific community. Cooperative learning gives students experience in collaborating with peers as well as communicating with others.

This literary review summarizes the research behind cooperative learning, emphasizing why it is important for adolescent science education and education in general. A description of

the theoretical framework behind cooperative education and a thorough explanation of its five components are also presented. Finally, based on recent research, there is an overview, at the end of the review, of ways to implement cooperative learning including assessment and scaffolding strategies.

### Cooperative Learning in the Science Classroom

Johnson, Johnson & Houlbec (1994) suggested three major approaches a teacher can utilize when facilitating instruction to a group of students. One is to promote competition among students by encouraging everyone to make an effort to be the best in the class. Another way is to have students work independently, and learn at their own pace. A third approach is to have students work together in small groups to achieve common goals.

In the average classroom today, there is too much focus on individualized and competitive education and not enough on cooperation. Shindler (2009), states that whether or not competition should be incorporated into classrooms at all, it is a prevalent practice and is likely to continue. Competition can have negative effects on students' learning. Vallerand, Gauvin & Halliwell (2001) conducted a study on 11 and 12 year old children to see the effects of competition on intrinsic motivation. They concluded that competition can interfere with an individual's intrinsic motivation to do an activity. This is probably because competition offers a form of extrinsic motivation. Once the competition is over, from the learner's perspective, there is no other reason to continue the activity.

Having students do everything individually can also have negative effects on learning. Watson, (2001), claims that students with learning disabilities are likely to show dependence rather than autonomy when learning through individual activities. When working by themselves, students can feel vulnerable, and either give up on their academic achievement or overly depend on the teacher. Ironically, working in groups can actually help students become more autonomous as depending on peers encourages students to depend on themselves as well. As Johnson, Johnson & Roseth (2010) point out, cooperative learning has a positive impact on psychological health, including self-esteem, when compared to competition and individualized learning. More importantly, as Mesch, Johnson, & Johnson (2001) state, “In the U.S., cooperation appears to promote higher achievement among students than either competitive or individualistic effort” (p. 345).

Using cooperative learning in science could also help students to see that the practice of science involves a community of researchers who collaborate and debate with each other to develop conclusions. In other words, cooperative learning strategies can help students understand that scientific knowledge is socially constructed. Scientific research is usually done by groups of scientists (Lo, 2013). However, Richard and Bader (2010) show that adolescent students have a naïve concept of how scientific knowledge is constructed. Most students, in the study, viewed science as an objective subject with one right explanation for every phenomenon. Students should see that there are various views among the most highly accredited experts. Learning science in cooperative groups should encourage students to see science as an area where they can contribute their own ideas and views rather than mindlessly conform to what the experts claim. This may be why ‘jigsawing’ is an appropriate cooperative strategy in science education as it mimics what goes on in the real scientific community (Rico & Shulman, 2004).

When science is seen as a more subjective discipline, students can be encouraged to share their ideas with each other, and cooperate to gain deeper understandings of the topic.

### Theoretical Background

In general, cooperative learning falls under the ideas of constructivism. Each individual has their own set of knowledge schemas which may not agree with the content being taught. To successfully implement cooperative learning in the classroom, teachers must have a solid understanding of both cognitive constructivism and social constructivism. Cooperative learning is related to constructivism as it is a student centered approach, and it allows students to actively construct knowledge in their own way (Tran, 2013).

The constructivist learning theory states that learners are constructors of knowledge rather than passive recipients of it (Tran, 2013; Powell & Kalina, 2009; Barwood, 2000; Watson, 2001). Both cognitive constructivism and social constructivism claim that people construct meaning from interacting with each other and their environments (Powell & Kalina, 2009). Academic achievements for students are limited when they learn completely by themselves. To progress to a higher level the student needs guidance from a teacher or another student. With the right guidance, the student's gaps in understanding can be filled, and they can develop a more complete perception of a particular concept. Powell and Kalina (2009) believe that individual constructivism needs to be incorporated with social constructivism for constructivist learning to occur. Therefore, while it is important for students to constructively interact with the teacher and with each other, it is also important to understand that each individual is bringing a unique perspective to the class.

To understand the ideas of cooperative learning, it is important to further discuss social constructivism. Social constructivism is based on the idea that individuals learn by actively building new information onto what they already know. Students need other, more knowledgeable individuals to help them build onto their understanding within their zone of proximal development (ZPD) (Watson, 2001). Vygotsky defines the ZPD as, “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.” (Vygotsky, 1978, p.86). In other words, the ZPD is an idea of how far a student can develop his/her understanding of a concept with guidance from another individual. The teacher’s understanding of a topic may be too far beyond that of the students to teach the topic within the students’ ZPD. Being ‘on the same level’, peers may be better suited for conveying content to students within their ZPD. Therefore, a constructivist teacher encourages dialogue between the students, as well as between the teacher and the students (Watson, 2001). According to social constructivism, individuals learn through social interaction. “We learn by moving from the interpsychological plane to the intrapsychological plane” (Barwood, 2000, p. 42). Therefore, the social context in which we learn is crucial. This suggests that a group education method like cooperative learning could provide students with genuine learning opportunities in the classroom.

Cooperative learning is most specifically based on the social interdependence theory. Johnson, Johnson & Roseth (2010), state, “Social interdependence exists when the accomplishments of each individual’s goals is affected by the action of others.” (p. 3). Social interdependence is split into two types: Positive interdependence (PI) and negative interdependence (NI). PI exists when students can achieve their goals only if the other members



of the group achieve their goals as well. NI exists when individuals can achieve their goals only by making sure the students they are competing against fail to achieve their goals. Competition is driven by NI. When there is no interdependence at all, individuals can achieve their goals without any influence from others. Social interdependence theory states that the way in which interdependence is structured determines how individuals will react and the interaction pattern of the individuals will determine the outcome (Johnson et al. 2010).

Johnson, Johnson & Roseth (2010) explain cooperative learning as a type of peer learning. Peer learning is a broad term for any activity involving groups of students working together to learn a topic or complete a task. Whether positive or negative, peers can have a strong influence on students compared to the influence of adults like parents, teachers or coaches. However, many theorists and researchers have argued for the positive impact of peer relationships. Since peer influences have the potential to be negative, student to student interactions need to be structured to ensure positive outcomes (Johnson, Johnson & Roseth, 2010).

### Educational Benefits of Cooperative Learning

Research has revealed many educational benefits from the use of cooperative learning. These include high academic achievement, improved peer relationships, effective for diverse students, and improved writing skills. Overall, cooperative learning leads to a higher quality education for students.

Cooperative learning leads to high academic success. Everyone involved in education wants to see students achieve the highest grades possible. Johnson, Johnson & Roseth (2010)

state, “Positive peer relationships tend to be related to achievement, classroom grades, standardized test scores, and IQ.” (p.7). Cooperative learning allows for positive peer relationships to develop.

Particularly in the subject of science, cooperative learning has also been connected to superior intellectual performance. Ajaja (2013), conducted a study on the effects of cooperative learning on the teaching and learning of biology compared to other teaching strategies. The study provided evidence that cooperative learning results in higher academic achievement, for students in the subject of biology, than pure lecturing and other individual learning strategies. Koc, Doymus, Karacop & Simsek (2010), showed that cooperative learning techniques can result in high academic achievement for students learning chemistry. They had a group of chemistry students work with a jigsaw activity, another group carried out collaborative investigations, and a control group was taught by traditional methods. Students from both the cooperative learning groups displayed better achievement than students from the control group. It may be worth mentioning that students in the jigsaw group achieved the highest on the academic assessments suggesting that the jigsaw method is highly effective in science education.

In any academic subject, especially science, writing skills are important. Good writing skills allow students to express themselves, and show teachers what they know or have learned about a topic. Barwood (2000), claims that writing development could be enhanced from cooperative learning as students can learn a lot more from peers than from the teacher. Students tend to understand their peers better than their teachers. Writing skills are very important in science as students express their understanding of concepts through words. After completing a lab activity, it is very important for students to write lab reports that express what they learned. Therefore, cooperative learning can be beneficial for writing activities.

Positive relationships with peers are important for adolescent students. Students who develop healthy relationships can develop good social skills which will serve them well in their adult careers. Middle school studies showed that cooperative conditions were associated with an increase in interpersonal attraction between students when compared to students in competitive and individualistic conditions (Johnson et al. 2010). If done right, students should develop increased interpersonal skills every time they participate in a cooperative lesson.

With so much diversity in the U.S., inclusive education is being pushed. Cooperative learning provides ways for students to present material to each other. It provides diverse teaching for diverse learners. By helping each other, students are able to understand the concepts more clearly for themselves (Johnson et al. 1994). Jones & Sterling (2011) , claim that cooperative learning can allow for effective learning in an inclusive classroom. Diverse learners need more than one kind of teacher, and cooperative learning allows students to teach each other. This way, there are a variety of ‘teachers’ for a variety of learners.

### The Essential Components of Cooperative Learning

Johnson et al. (1994) established cooperative learning as a type of small group learning strategy that is distinguishable from other forms of group work or peer learning . Lin (2006) defines cooperative learning as “an instructional method in which students work in small groups to accomplish a common learning goal under the guidance of a teacher.” (p.34). According to Johnson et al. (1994), cooperative learning involves students working together to achieve outcomes that are not only beneficial to themselves, but beneficial to the entire group. If even one student is falling behind, the rest of the group cannot progress.

There are five essential components that must be present in a group learning strategy to be considered cooperative learning. These components are known as positive interdependence, promotive action, individual accountability, interpersonal or social skills, and group processing. A cooperative learning strategy must contain all five of the essential components. The components are described below.

### *Positive interdependence*

Positive interdependence is the idea that every student in the group has an important contribution, and that the group cannot succeed unless each student does his part. Johnson et al. (2010) state, “Positive interdependence is the heart of cooperative learning” (p.8). With positive interdependence, every student has to contribute to the group, or the group will not achieve its goal. Tran (2013) points out that positive interdependence occurs when students are ensuring that other members of their group are completing the task and achieving the goals. No student in the group is able to obtain a ‘free ride’, because if one member performs poorly, the whole group will have to face the consequences. Therefore, by constructing positive interdependence in group activities, teachers can encourage students to be actively participating members of their group.

Teachers can structure positive interdependence by setting group goals, and rewarding all members of the group in the same way upon achieving their goal. Assigning specific and well defined roles to each member contributes to positive interdependence. The roles must be complementary to each other, and interconnected. Johnson et al. (2010) explain that positive interdependence can be implemented through mutual goals, joint reward, divided resources, complementary roles, or a shared identity. It is important that each student has a unique

responsibility. As Tran (2013) points out, students who see their potential contribution to the group as unique will increase their efforts.

Teachers can also design activities where each member of the group has one portion of the total necessary resources to complete the task (Johnson et al.1994). This is known as positive resource interdependence (Johnson, Johnson & Stanne, 2001). However, Sarfo & Elen (2011) conducted a study which showed the portioning of resources between group members to have a negative effect on academic achievement. They compared the academic achievements of students who worked in groups, each with the full content, to students who worked in groups, each with just a portion of the content. Students from groups with the full content performed better on the academic assessment. The study, conduct by Sarfo & Elen (2011), shows that splitting up the content between students in a group (positive resource interdependence) may not be beneficial to learning. However, positive interdependence in general may still have a positive impact on cooperative learning.

Johnson, Johnson & Stanne (2001) also conducted a study on the effects of positive resource interdependence on academic achievement. In addition, they looked at positive goal interdependence (PGI). Mesch et al. (2001) define positive goal interdependence as the condition in a group, “when students perceive that they can achieve their goals if and only if the other students with whom they are cooperatively linked achieve their goals” (p. 345). In their study, which focused on 44 Black American students who had just finished high school, Johnson et al. (2001) also found that positive resource interdependence, by itself, resulted in lower academic success than students working individually. The PGI condition had a similar negative effect as the positive resource condition. However, students who worked in a condition, where both positive resource interdependence and PGI were implemented, achieved the greatest

academic success (Johnson, Johnson & Stanne, 2001). This suggested that it is the combination of various positive interdependencies that leads to higher academic performance for learners.

Ortiz, Johnson & Johnson (2001) conducted another study on the effects of PGI and positive resource interdependence. This time the subjects were fifth grade students. They came to the same conclusion that PGI and positive resource interdependence by themselves were not effective, but that both of them together resulted in the best academic performances. This study also displayed that students in the grouped conditions did not show positive results right away. It took about three weeks of group work before the students in PGI and positive resource interdependence conditions showed high academic achievement. This suggests that students need time to learn how to do well in groups, perhaps to understand group procedure or develop social skills, before they can benefit from cooperative learning (Ortiz et al. 2001).

Mesch et al. (2001) investigated the effects of another type of positive interdependence along with PGI. The other type is known as positive reward interdependence (PRI). Mesch et al. (2001) define PRI as the condition, “when each member of a cooperative learning group receives the same reward for successfully completing a joint task” (p. 346). They used two 10th grade social studies classes to examine the effects of PGI and/or PRI on academic achievement. During the 24 week long study, the students in the experimental class were taught without cooperative learning, with PRI by itself, PGI by itself, and with both PRI and PGI. The highest academic achievement was seen when students were taught with PRI and PGI together. Next, the students were taught individually, and they were able to maintain their high academic achievement (Mesch et al. 2001). This study, like those above, suggests that more than one variety of positive interdependence used at the same time can have a better impact than one by itself. It also shows that the impact of cooperative learning can last for future lessons. After

learning in positive interdependent conditions, the students may have developed as individual learners.

### Promotive interaction

Promotive interaction is the term for students helping each other to succeed. If positive interdependence is clearly established, students should recognize that it is in their best interest that every member of the group performs well (Johnson et al. 1994). Tran (2013) states that promotive interaction results from the effective implementation of positive interdependence. Therefore, as Johnson et al. (2010) point out, promotive interaction exists when students have opportunities and the motivation to encourage each other to succeed by assisting, supporting and praising one another. The quality of group interactions depends on the academic levels of each member in the group, the establishment of a positive learning environment, and small group size (Johnson, Johnson & Houlbec, 1994).

### Individual accountability

Individual accountability or personal responsibility is an important component for group learning. Each student needs to be held accountable for the final outcome of a task. Otherwise, certain group members could do nothing while the other students complete the group task. Like promotive interaction, individual accountability arises as a result of positive interdependence. Tran (2013) states that positive interdependence can create ‘responsibility forces’ which cause students to hold themselves responsible as well as helping other students to do their part. Individual accountability exists when each individual is assessed and the results are given to the group and the individual to see who needs to be contributing more. Teachers can implement individual accountability through individual tests, observations of groups to ensure everyone is

equally contributing, and assigning a student in each group the role of checking that each member is understanding everything (Johnson et al. 2010). Keeping groups smaller than 5 students makes individual accountability easiest to achieve. Basically, students should learn the material together, and then display their understanding individually.

Sarfo & Elen (2011) conducted a study to show the positive effect that individual accountability had on the academic achievement of students in cooperative learning. They looked at the academic performances of students who worked in groups who were told that the grade of each student in the group would be based on the test results of one randomly picked individual from the group. They compared the above test results to the results of students from groups whose grades were not depending on one individual. The students from the former groups performed better on the academic assessments than those of the latter group. Any student, in the former groups, could be responsible for their whole group, so every member of the group was motivated to make an effort to learn the content of the lesson. Also, when the grade of every member of the group depends on one unknown individual, the members may be motivated to make sure their peers understand the content. This may contribute to positive interdependence as well as it causes the students to depend on each other to do well.

### *Interpersonal skills*

Effective cooperative learning also depends on the interpersonal skills of the students. These skills need to be taught as they are not instinctual. To develop interpersonal skills, Johnson, Johnson & Houlbec (1994) argue that students must get to know each other and build up trust, they must communicate as clearly as possible, they must accept and support one another, and they should be able to constructively resolve conflicts. Without the proper social



skills, students will not interact well, and therefore make no progress in the group task. Tran (2013) claims that social skills promote positive relationships between students along with higher academic achievement.

Teachers need to show students what interpersonal skills are, and they need to encourage students to use them. Rico & Shulman (2004), found that it is important to start a dialogue between students, and teachers need to help students communicate. Without communication skills, students will not make progress with cooperative learning activities. Herron (2009) suggests that science teachers should be trained in interpersonal skills before teaching students. When teachers build positive relationships with students, students can show personal, intellectual and academic achievement. Furthermore, if students are to display positive interpersonal skills, their teacher would be the most important role model. By demonstrating effective interpersonal or social skills and building positive relationships with students, teachers can set the standards for how students should behave when interacting with each other.

### Group processing

A fifth essential condition for cooperative learning is group processing. This is where students reflect on how well their group performed. It could be considered the metacognitive process of social learning. Group processing must take place at the conclusion of a lesson (Johnson et al. 2010). “Social interdependence theory posits that group processing is an important mediating variable between cooperation and achievement.” (Bertucci, Conte, Johnson & Johnson, 2012, p. 334). Group processing allows students to progress as cooperative students. It involves two major steps: students must first identify which actions of the group members contributed to goal achievements and which did not, and the next step is for students to

decide which actions to continue with next time and which ones to eliminate. It may take time to see the benefits of group processing as students have to build up experience in group work before they can figure out what works and what does not (Bertucci et al. 2012).

Bertucci, Conte, Johnson & Johnson (2012), conducted a study to identify the effects of group processing on academic achievement for 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> grade Italian students. The students had no experience with cooperative learning. Both the experimental and control groups completed five 90-minute cooperative learning sessions. The experimental group had group processing time at the end of each session while the control group did not. Students in both groups were given quizzes to assess what they learned after each session. There was no significant difference between the groups after the first three sessions. However, the quizzes after sessions 4 and 5 revealed a significantly higher achievement by the students in the experimental group who employed group processing. While this study shows group processing to have a positive effect on academic achievement, it also demonstrates that students need to build up experience with processing as the experimental group did not outperform the control group until the 4<sup>th</sup> and 5<sup>th</sup> sessions. By making the time for processing, students will most likely improve their group skills every time they do a group activity(Johnson et al.1994; Bertucci et al. 2012).

### Implementation , Scaffolding and Assessment

Johnson, Johnson & Roseth (2010), gave suggestions for implementations of cooperative learning. First of all, groups should consist of 2 to 4 students. Five or more becomes too many students to be effective as it limits the contributions that each individual can make. Groups of

students should be arranged in horseshoe shapes so that students can face each other and the teacher at the same time. It is important for educators to make sure that students realize that they need to help each other understand how to get the right answer, and that just giving each other the answers is not helpful. Teachers should have each student in the group sign the completed work confirming that they not only agree with the answers, but that they can explain how they got each one, and that each other individual in the group can explain each answer as well. It is also important for instructors to structure activities in a way that sets students up for positive yet honest feedback. Finally, at the end of each lesson, teachers should make sure groups celebrate in some way, even if it is as minor as just ‘high fiving’ each other (Johnson et al. 2010).

Johnson, Johnson & Roseth (2010), also describe three types of cooperative learning referred to as formal cooperative learning (FCL), informal cooperative learning (ICL), and cooperative base groups. FCL involves a planned out lesson. The teacher plans out the goals the students must achieve and gives detailed instructions to the students. The teacher monitors the students during the lesson, and assesses the students during and after the lesson. ICL consists of instructing students to work together for a common learning goal for a temporary time that could be as short as a few minutes, but no longer than a class period. Cooperative base groups are a heterogeneous set of students meant to work together for a long term, usually the entire course (year or semester). They can meet regularly every day or week to support each other with homework or other routine tasks.

ICL and FCL would be the two types of cooperative learning to consider in the classroom. Cooperative base groups, on the other hand, would be set up school-wide, and would probably involve the school administration. Therefore, a teacher needs to decide when to use ICL and when to use FCL. Barwood (2000), claimed that teachers should start with formal

cooperative learning until students develop adequate interpersonal skills. Students can then move on to informal cooperative learning. Therefore, it is important that teachers give students highly structured cooperative activities when implementing cooperative learning for the first time. As students become more competent with group work, some of the structure can be taken away, and eventually informal cooperative learning can be used.

Further implementation strategies come from Jones & Sterling (2011), where they presented three steps to effectively incorporate cooperative learning activities in an inclusive science class. The first step is to get to know the students and observe how they interact with each other. This can be accomplished through ‘ice breaker’ activities. It is also helpful to have students change where they sit from day to day. Step two involves the construction of a seating plan grouping students together that will allow for the most effective learning. The third step entails the implementation of cooperative learning strategies. Jones & Sterling (2011) go on to describe three cooperative learning strategies. They are, ‘Round-Robin’, ‘Peer Coaching’ and ‘Using White Boards’. Each strategy has its own strengths and weaknesses. Deciding which one to use would depend on what topic is being taught, and knowing what kinds of activities a particular group of students does well with.

The internet could prove very useful for implementing group activities. William, Cameron & Morgan (2012) explored the significance and challenges of online group work at the college level and came up with suggestions for making online group activities work. The teacher should structure the task to be something meaningful so that students will take it seriously. This could mean giving the project a purpose. Another suggestion is for instructors to create some small introductory assignments with the purpose of having students get to know each other and practice group work. This will help students get the most out of their group work during the

actual assignments. William et al. (2012) also recommend using an online sharing program that shows what is coming from each group member. This is a good way to encourage sharing of information while showing the instructor which members are contributing the most. The instructor, therefore, has a way to individualize grading. It's also a good idea for teachers to provide students with ways to assess each other. William et al. (2012) describe a questionnaire chart which allows the student to assess him/herself as well as each other member of the group. Peer assessment is a good way to have students reflect on how everyone, including themselves, did. It also provided the teacher diverse feed back to help with grading everyone. William et al.(2001) also suggest having groups present their projects. The presentation of group projects is an authentic way for an instructor to assess the project.

Lo (2013), applied a wiki online discussion forum to an undergraduate course on physics experiments. A study was done on 58 students, in Taiwan, as they used the wiki to collaborate on lab reports. Lo's observations revealed evidence of positive interdependence, promotive interaction, individual accountability, social skills, and group processing supporting that this was a cooperative learning activity. So, a combination of internet software and collaborative learning can be useful for writing group lab reports in science.

### Scaffolding

Learners often have difficulties with collaborative projects. For one thing, many students lack the interpersonal skills for any type of group work. These are skills that must be learned. As Rico and Shulman (2004), pointed out, it is important for teachers to help students communicate with each other, because students will not make much progress in cooperative activities if they can't communicate well. Students also can have trouble staying focused on the

task, and they can distract each other when working in groups. Another common difficulty for students working in groups is that some students do most of the work while others do very little. For all of these difficulties, students need instructional support or scaffolding. Scaffolding is assistance given to a student to help them achieve a task that they could not achieve without it. For collaborative learning, students can receive scaffolding for understanding content or concepts, but they can also receive scaffolding to support them with social interactions (Kollar, Fischer & Hesse, 2006).

When implementing cooperative learning, teachers already have a way to provide scaffolding for students. For example, Watson (2001) uses the main ideas of social constructivism to argue that the act of having students collaborate in itself is a way to support(or scaffold) students with disabilities. From her observations, Watson claims, “pupils can enrich each other’s learning” (2001, p. 143). By explaining their ideas and points of views to other students, they give themselves an intellectually stimulating experience. Teachers should set up activities where students must share their ideas or thoughts. Students can increase their metacognitive awareness by gaining an understanding of various viewpoints on a topic (Watson, 2001). In the study by Mesch et al. (2001), 4 students with learning disabilities were placed in the experimental class. Each of the four students was placed in a group with 3 students at medium or high academic levels during the cooperative activities. The results showed that the students with disabilities benefited from cooperative learning while the mainstream students were not hindered. This demonstrates that cooperative learning can work for diverse learners.

One great way to scaffold cooperative or any type of group learning is by using a collaboration script. Kollar et al. (2006), defined a collaboration script as, “an instructional means that provides collaborators with instructions for task-related interactions, that can be

represented in different ways, and that can be directed at specific learning objectives” (p. 162-163). Scripts give students instructional guidance as to how they should act and what they should do in a group task depending on what role they are playing. Kollar et al. (2006) concluded that collaboration scripts must have five components: learning objectives, type of learning activities, sequencing of activities, role distribution mechanisms and type of representation. Having identified these aspects, Kollar et al. (2006) investigated 8 different collaboration script approaches. Four were meant for face-to-face group work, and the other four are offered as computer software programs. The face-to-face approaches all assist students with understanding the content as well as helping them gain elaborative skills and metacognitive techniques. Overall, the ‘in person’ scripts focus on supporting the progression of the individual during group work. Also, these face-to-face scripts are highly structured which can be very helpful for students who need a lot of support. However, there is a danger in having too much structure in a script, also known as ‘over-scripting.’ Kollar et al. (2006), provide evidence that motivation can suffer when collaboration scripts are too detailed.

The computer mediated collaboration scripts were, overall, different from the face-to-face approaches. They mainly supported students in learning specific content, as well as interpersonal skills. Overall, there is more of a focus on supporting the group over the individual. Also, computer programs offer more freedom to students in higher order activities like explaining or commenting. So, the computer mediated programs are not so rigidly structured like the face-to-face approaches. This is good depending on how comfortable and skillful students are at constructing explanations (Kollar et al. 2006).

In conclusion, Kollar et al. (2006), decide that the best designed collaboration scripts would be able to support both individual and group processes at the same time. Most scripts put

primary focus on either the group or the individual giving unequal attention to both domains. Kollar et al.(2006), stated, “Learners with low domain-specific knowledge might learn best with highly structured collaboration scripts, whereas learners with high domain-specific knowledge may learn best with minimally structured collaboration scripts” (P. 178). The teacher should have different scripts and know when to use which one. As educators implement group activities with scripts, they should be aware of the progress students make in their knowledge of collaboration. Kollar et al. (2006) explain that students can develop an ‘internal script’ that allows them to collaborate with peers without the support of an ‘external script’. Therefore, as students progress throughout a course, the teacher should be able to gradually take away script structure pushing students to become autonomous collaborators.

#### *Assessing cooperative learning*

Assessment can become complicated in cooperative learning. One solution to assessing group work is to have students help carry out the assessments. Kao (2013) investigated the use of peer assessment with positive interdependence (PAPI). Many studies have found positive results with peer assessments. However, some downsides to peer assessments are favoritism, unfairness, distortion of marking, low quality comments and a lack of engagement. PAPI is designed to counter those threats, mainly carelessness and favoritism. By incorporating an element of positive interdependence and individual accountability, it is hoped that PAPI can reduce or eliminate ‘free riding’. That is, with PAPI, students assess other students more seriously and with more effort (Kao, 2013).

The PAPI program contains two scores, the assignment score and the self/peer assessor score. The assignment score is given for the actual assignment, and is based on the evaluations



from peers. The self/peer assessor score is an assessment of the student's assessing. It is based on which student project they end up rating the highest. If it agrees with the majority of other students, they get a good score. "Quality achievers" will probably achieve a high assignment score where "critical assessor" will probably achieve a better assessor score. The teacher can determine how much weight each score should have based on which area the students need further development (Kao, 2013).

Kao (2013) conducted a study of PAPI on 14 graduate students in Taiwan. They were split into 6 groups and each group had to design a website on a certain topic. Students were given two months to complete the websites, and then they were trained on how to assess each other. Assessments were performed individually in a normal condition, and in the PAPI condition. Evidence was produced that the PAPI conditions caused students to consider the views of others in addition to their own when assessing their peers (Kao, 2013).

### Summary and Implication

When constructing cooperative learning lessons, it is important to apply the research. It seems that the most crucial piece to consider is the inclusion of the five components of cooperative learning. The activity or lesson is technically not considered cooperative learning unless all five components are present. Therefore every lesson in this project will contain all five cooperative learning components.

Of all the components, positive interdependence seems to be the most crucial. Based on the social interdependence theory, the interdependence between students is what makes an

activity cooperative. If interdependence is positive, then the group must cooperate. If interdependence is negative or non existent, then student will have no reason to cooperate. Once positive interdependence is established, it leads to promotive interaction and individual accountability. If students are depending on the success of their peers to do well, then they are likely to encourage them. Also, if students are dependent on each other, it probably means each student has their own responsibility or contribution which will also promote individual accountability.

Teachers should be cautious when establishing positive interdependence. As the research shows, positive interdependence, specifically positive resource interdependence, can lead to lower academic achievement among group members. However, combining more than one type of positive interdependence leads to higher academic achievement. So, it would seem that there needs to be more than one method of establishing positive interdependence in each lesson. Therefore, the lessons in this project will each contain multiple implementations of positive interdependence.

The research shows that the best way to promote interpersonal skills is for the teacher to be a role model to the class. If the teacher had poor interpersonal skills, cooperation between students will be inhibited. The teacher needs to observe different groups of students and make sure they are using good communication skills, and being respectful. When the teacher sees good examples, or bad ones, of student interactions, he/she can share them with the class to demonstrate to everyone how people are supposed to interact with each other. However, the teacher can't be everywhere at one time. He/she may miss things. Therefore, in some of the lessons of this project, a role will be assigned to a student requiring him/her to report to the teacher if there are any conflicts between students that aren't being resolved professionally.

Also, a student with this role may feel pressure to exhibit his/her best interpersonal skills and therefore be a good model to his/her peers. Other than that, each lesson plan will point out opportunities for the teacher to observe group interactions.

The research shows the benefits of group processing. The benefit will not be seen right away, but group processing, when done right, allows students to improve their cooperation skills for next time. It gives students an opportunity to think about how they did, and what they could've done better. A challenge with this is getting students to think sincerely about themselves and their peers. This is where peer assessments might help. It would probably be beneficial to have students to a quick evaluation of themselves and their group mates before starting an in depth discussion. With that in mind, the lessons in this project will each have a quick peer review at the beginning of group processing. Then students will discuss with their group members their strengths, weaknesses, and what they can do better next time. This would hopefully lead to quality group processing.

The research shows 3 major types of cooperative learning. They are informal cooperative learning, formal cooperative learning and cooperative base groups. The only type that will be used in this project is formal cooperative learning as each of these activities will be well planned out. Informal cooperative learning should be used with students who have mastered cooperative learning, and cooperative based groups are a school wide effort which the administration would organize.

Also, the research suggests that no more than four students should be in a group. This project will contain lessons with groups of three students, and never more than four.



## **Chapter III: Cooperative Learning in Living Environment**

### Overview

This chapter includes 10 lessons for the New York State living environment high school course. Each lesson contains the five cooperative learning components. At the beginning of each lesson, there is a brief description of how the lesson is significant. These lessons do not have to be done in any order, and they do not depend on each other. Teachers can pick and choose any lesson they want to use at any time that suits their objectives. The following is meant to be a sampling of the many uses of cooperative learning within the content of biology.

### Project Outline

This project consists of a collection of cooperative learning lessons that follow the Key Ideas of the New York State regents standard 4 for living environment. The lessons have been designed for high school students in 9<sup>th</sup> and 10<sup>th</sup> grade. Each lesson incorporates the five essential components of cooperative learning: positive interdependence, promotive interaction, individual accountability, interpersonal skills, and group processing.

### Lesson Topics

<b>Lesson</b>	<b>Purpose for Using Cooperative Learning</b>
1. Living or Non – Living	To ensure that each student thinks critically about the difference between living things and non living things.
2. Populations and Communities	To increase the likelihood that students will see the issue of human impact from both sides.
3. DNA Translation	To ensure that every student will participate in independent thinking.
4. The Nature of Enzymes	To help students participate in a science lab using inquiry.
5. DNA Replication, Transcription and Translation	Cooperative learning will promote peer to peer interactions which will result in every student understanding the central dogma of DNA.
6. Mitosis	Cooperative learning will help students come to the conclusion that mitosis in multicellular organisms takes place where there growth.
7. Cellular Respiration	Cooperative learning will promote the use of scientific inquiry in this lesson.
8. Natural and Sexual Selection	Cooperative learning will assist students in the understanding of a complex concept in evolution.
9. Build A Phylogenetic Tree	In this lesson, cooperative learning will help each student to develop an important skill for deeper understanding in evolution.
10. Human Impact Project	Cooperative learning will promote the exposure and learning of many different topics and subtopics having to do with human impact on nature.

## Lesson Structure

Each lesson is set up with the following structure:

Lesson Number and Title		
Significance of the lesson – A short write up of why the cooperative components of the lesson are important.		
Grade Level	Subject	Duration
Knowledge and Skill Prerequisites – The skills and knowledge students should have before participating in the lesson.		
State Standards – A list of performance indicators and key ideas from the New York State standards that the lesson covers.		
Objectives – a list of learning goals that students should reach by the end of the lesson.		
Materials – a list of all the supplies and resources necessary for the lesson.		
Scaffold Suggestions – Brief descriptions of possible ways to modify the content to make the lesson achievable for as many students as possible.		
Procedure – This section includes step by step directions for administering the lesson. It includes an anticipatory set, the main body of the lesson and a closure section which will always involve group processing.		Cooperative Components – This section will show each cooperative component and explain how each one was used in the lesson. A description of a component will be labeled with a letter and number which will be indicated in bold by the step in the procedure where it takes place. The cooperative components codes are based off of the cooperative components key, below, which explains a variety of ways that each component will be used in the lessons. *
Assessment – A list of all the ways to assess student, both individually and cooperatively, throughout the lesson.		
Attachments – Copies of any worksheets or documents necessary for this lesson.		

## Cooperative Components Key

\* Each lesson uses the five cooperative components in different ways. Below, is a key describing all the various ways the cooperative components will be used. Each description is labeled with a code. Each lesson will use a code from the key, in the cooperative component section, if the component was used in that way.

### **Cooperative Components Key:**

#### **A-Positive Interdependence**

1. Assigning well defined roles can contribute to positive interdependence. If each student has their own unique responsibility, then each student contribution is necessary for the success of the group.
2. To promote interdependence, some type of reward can be given to the whole group if all members of the group individually achieve a certain grade or level of performance.
3. When each group member has their own part of the resources for completing the activity, then students will become dependent on each other.
4. Students can become dependent on each other when each individual feels a strong responsibility towards the success of the group. This can be achieved by having each member represent the group in an activity like a 'jigsaw'. It can also be achieved by making each individual responsible for the grades of the group. Each individual can feel responsible for the group grade if they each have their own unique contribution towards the group grade. Another way for each group member to feel responsible for the group grade is to have every member complete a task, but randomly select only one to grade when everyone is finished.

#### **B-Promotive Interaction**

1. If positive interdependence has been effectively established, students should be motivated to encourage each other to do well.
2. A role can be assigned that requires the student to encourage other members.
3. When group processing takes place, students can reflect on how encouraging they and their team members were. This can increase promotive interaction for the next cooperative activity.

#### **C-Individual Accountability**

1. If each member is given their own unique role or assignment, they will each have their own individual responsibility in achieving group success.
2. A role can be given where the student should make sure other students are doing their part.
3. If **A-4** (See above) is achieved, it should strongly promote individual accountability by putting pressure on each student to do his/her best.
4. During group processing, students should reflect on how much they and their team members each contributed and decide who needs to work more next time.

#### **D-Interpersonal Skills**

1. A role can be assigned to a student requiring them to report to the teacher if there are negative interactions taking place between students.
2. The teacher should always look for opportunities to teach interpersonal skills.



Once the activity is explained, the teacher might give an example of how students should interact with each other. Also, if the teacher sees an example of good quality interpersonal skills in one of the groups, point it out to the whole class and explain what was good about it. Also, if the teacher sees an example of poor use of interpersonal skills, the teacher should point it out to the class and explain how the students should have communicated.

3. The group processing exercise can help with interpersonal skills because it provides students an opportunity to recognize positive or negative interactions they made with each other.

#### E-Group Processing

1. 10 minutes must be reserved for the group processing exercise at the end of each lesson.
2. Students should discuss what went well, what went poorly and what they should do differently next time.
3. Peer assessments can reinforce group processing. They can prompt students to think back upon certain aspects of the group collaboration.

## Lesson 1 – Living or Non-Living

### Significance of Lesson

Teaching the characteristics of life can be simple and straightforward, but it is when these characteristics are applied to actual objects that the line between alive and not alive can become very unclear. Students will find it very difficult to classify many of the objects in this lesson. However, the point of this lesson is not to classify each object correctly, but to promote students to think critically about the difference between living things and non living things. This is where cooperative learning can be useful.

Cooperative learning provides a means to facilitate thorough examinations of each object. As students work together, each individual will be motivated to do his/her fair share while helping their peers to succeed. In this way students can help each other to gain insights they never would on their own. Without the components of cooperative learning, students are unlikely to have the motivation to help each other.

Furthermore, this activity provides a good way for students to practice communication and collaboration skills. According to the National Education Association, students will need to develop their abilities in critical thinking, communication, collaboration and creativity(the four-C's) to be productive members of a global society (NEA, 2012). This lesson provides students with opportunities to make compromises with peers. Students will work in groups of three to make decisions about subjective topics. They will have to consider the ideas of their peers and logically present their own thoughts to do well.

<b>Grade:</b> High School/9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"> <li>• The majority of students should possess, at least, a 7<sup>th</sup> grade reading level.</li> <li>• The majority of students should possess basic inter-personal skills.</li> <li>• Students should have successfully completed the 7<sup>th</sup> grade life science course.</li> </ul>		
<b>State Standards:</b> <ul style="list-style-type: none"> <li>• Standard 4</li> <li>• Key Idea 1: Living things are both similar to and different from each other and from nonliving things.</li> </ul>		
<b>Objectives:</b> <ol style="list-style-type: none"> <li>1. Students will understand that the question of whether something is alive or not can be complicated.</li> <li>2. Students will realize that there are several(not just one) characteristics all living things must have to be considered alive.</li> <li>3. Students will understand that something that is dead is different than a nonliving thing since it was once alive.</li> <li>4. Students will understand how important it is that biologists have established several characteristics of living things.</li> </ol>		
<b>Materials:</b> <ol style="list-style-type: none"> <li>1. 10 to 15 specimens including things that are alive, things that are not alive and things that are dead. Some suggestions: rocks, potted plant, freshly cut flowers, yeast in warm water bath, candle with lit flame, microscopes set up with slides like elodea or a wet mount with just an air bubble, mold growing on food, cork, apple, seeds.</li> <li>2. Data Table (attached)</li> <li>3. Post lab questions (attached)</li> <li>4. Peer Evaluation Form (attached)</li> <li>5. Group processing questions(attached)</li> </ol>		
<b>Scaffold Suggestions:</b> <ul style="list-style-type: none"> <li>• Print out descriptions for each role which can be provided for students to make their responsibilities more clear to them.</li> <li>• Group students together, so that lower achieving students are able to work with higher achieving students.</li> </ul>		
<b>Procedure:</b>  <u>Anticipatory Set:</u> <ul style="list-style-type: none"> <li>• Light a candle and ask students if the flame is alive. <ul style="list-style-type: none"> <li>○ Start a discussion. Teacher might ask questions like: <ul style="list-style-type: none"> <li>▪ What do you think it means to be alive or dead?</li> <li>▪ How is 'dead' related to 'living'?</li> <li>▪ Does everything living have to have some qualities or characteristics?</li> <li>▪ What characteristics could nonliving things have that make them appear living.</li> </ul> </li> </ul> </li> </ul> <u>Body:</u>	<b>Cooperative Components</b> <ul style="list-style-type: none"> <li>• Positive Interdependence <ul style="list-style-type: none"> <li>○ A-1: The groups should consist of three students. Each student then has their own role: decision maker, recorder or ambassador. Group success will depend on each member fulfilling their roles.</li> <li>○ A-2: Students are given bonus points if all the group members can achieve a certain grade. Each member will get bonus points only if their peers</li> </ul> </li> </ul>	

- Have specimens set up around the room ahead of time. Make sure they are numbered.
  - Split students into groups of three. Each student must be given a role whether they are assigned or chosen. **A-1, C-1**
    - Roles are as follows:
      - Decision maker – this student makes the final decision after a discussion. For example, after students discuss whether or not a plant is living, dead or nonliving, the decision maker will tell the recorder what to write down. The decision maker is especially important when all students in the group cannot come to the same conclusion.
      - Recorder – this student is responsible for marking the chart and writing out any responses on behalf of the group.
      - Ambassador – this student is responsible for making sure everyone in the group is contributing to the activity, and that they are all respectful towards one another. He/she should encourage other students. If there is a problem related to student cooperation or participation, the ambassador must inform the teacher. **B-2, C-2, D-1**
    - All students are responsible for contributing to the activity.
  - Hand out a data table to each group.
    - Explain to the students that they must come up with their own characteristics of living things. The groups need to work together to establish 6 life characteristics before starting the activity. They can come up with two more characteristics as they observe specimens. The recorder must write the characteristics on the data table.
  - Assign groups to start at different stations and observe specimens to decide if they are living, non-living or dead.
    - Give a maximum of five minutes at each specimen. Each group needs to complete an analysis of at least 10 specimens.
    - Observe different groups and look for examples of good interpersonal skills and bad interpersonal skills that can be pointed out to the class. **D-2**
  - Hand out post lab questions to each group.
    - Each group must work together to discuss the questions, and answer them.
- succeed along with them.
- Promotive Interaction
    - B-1: Since positive interdependence is being established in this with the bonus point offer, students should be motivated to encourage each other to do well.
    - B-2: A reason for setting up the ‘ambassador’ role is to ensure that there is some promotive interaction taking place. Part of the ‘ambassador’ role is to encourage the other students in the group.
    - B-3: The group processing exercise will have an encouragement component.
  - Individual Accountability
    - C-1: With each role assigned, each student will be responsible for their own individual contribution.
    - C-2: One of the responsibilities of the ‘Ambassador’ role is to make sure other students are participating in the activity.
    - C-4: There is a component in the group processing that will address student participation.
  - Interpersonal Skills
    - D-1: The ambassador role requires the student to report to the teacher if group members are having issues communicating (i.e.-students are not getting along or there is an intense argument).
    - D-2: This is the point where the teacher should scan the groups and look for examples, positive or negative, of interpersonal skills. If the teacher finds a strong example, he/she should make sure to explain it well to the class.

<ul style="list-style-type: none"> <li>○ The post lab questions will be collected and graded individually. If each students scores at least 90%, the whole group will receive 5 bonus points. <b>A-2, B-1</b></li> </ul> <p><u>Closure:</u></p> <ul style="list-style-type: none"> <li>● Reserve at least 10 minutes for group processing. <b>B-3, C-4, D-3, E-1</b></li> <li>○ Hand out the ‘peer evaluation forms’ first. <b>E-3</b></li> <li>○ Hand out one group processing question sheet to each group. <b>E-2</b></li> <li>○ Encourage students to take their time and answer the questions as thoughtfully as possible.</li> </ul>	<ul style="list-style-type: none"> <li>○ D-3: The group processing exercise can help with interpersonal skills because it provides students and opportunity to recognize positive or negative interactions students made with each other.</li> </ul> <ul style="list-style-type: none"> <li>● Group processing <ul style="list-style-type: none"> <li>○ E-1: 10 minutes are to be reserved for group processing at the end of this lesson.</li> <li>○ E-2: Group processing questions are given to each student to discuss with group members.</li> <li>○ E-3: The ‘peer evaluation form’ can be given first. This will help students to start thinking of how they and their group members did.</li> </ul> </li> </ul>
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>● Check in with groups and observe how they are doing.</li> <li>● Assess the post lab questions.</li> <li>● Read over the ‘peer evaluation forms’ to see how students rated themselves and others.</li> <li>● Look over the ‘group processing questions’ to assess how cooperative learning went.</li> </ul>	

## Lesson 1 Attachments

## Student Handout 1 – Recording Table

[illegible]

## **Lesson 1: Student Handout 2 – Post Lab Questions**

Names:

**Post Lab Questions:** Work together to answer these questions once your data table is complete.

1. How did you determine the difference between a living specimen and a nonliving one?
2. What is the difference between a nonliving specimen and one that you considered dead?
3. According to your observations, what traits do nonliving things have in common with one another?
4. According to your data table, what traits do most living things have in common?
5. What traits did you list as characteristics of living things, but were not easily observable?
6. What instruments or technologies might have helped you to determine whether or not some of the unknowns are living or not?
7. What traits did you pick as characteristics that were NOT helpful (did not necessarily indicate life)?
8. What traits do you wish you had picked instead?

## Lesson 1: Student Handout 3 – For Group Processing

### Peer Evaluation Form

Name \_\_\_\_\_

Group Member Names:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Directions: Use this form to rate yourself and your group members using the number scale. Add up the points at the bottom to get each total.

Ratings: 5=Perfect 4=very good 3=good enough 2=could be better 1=very poor

Attribute	You	Member 1	Member 2	Member 3
Contributed to the activity.				
Encouraged others.				
Carried out role responsibilities				
Communication Skills				
Professionalism				
TOTALS				



## Lesson 1: Student Handout 4 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 2 – Populations and Communities

### Significance of Lesson

This lesson provides students with a controversial topic. It causes students to question whether humans should interfere with natural processes or not. There are rational arguments both for and against human interference. Students should be able to understand the issue from both sides. This is where cooperative learning can be useful.

Cooperative learning can ensure that students will gain genuine understanding of both the advantages and disadvantages of human interference. In each group, students are bound to have different thoughts and opinions about the topic of introducing predators into the wild. With the components of cooperative learning in place, students will have to work at reaching a compromise which will allow them to see the issue from both sides.

This lesson also provides students the opportunity to defend their position in front of a large group. They must use evidence from the activity to logically argue for a position on this issue. This is an important skill to have in science. One of the 8 essential practices for K-12 students in the Next Generation Science Standards is, ‘Engaging in Argument from Evidence’ (National Research Council, 2012). With the cooperative learning components in place, students are likely to become engaged in this debate while making an effort to defend their own position.

<b>Grade:</b> High School/9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"> <li>• The majority of students should possess, at least, a 7<sup>th</sup> grade reading level.</li> <li>• The majority of students should possess basic inter-personal skills.</li> <li>• Students should have successfully completed the 7<sup>th</sup> grade life science course.</li> </ul>		
<b>State Standards:</b> <ul style="list-style-type: none"> <li>• Standard 4</li> <li>• Key Idea 1: Living things are both similar to and different from each other and from nonliving things. <ul style="list-style-type: none"> <li>○ P.I. 1.1: Explain how diversity of populations within ecosystems relates to the stability of ecosystems. <ul style="list-style-type: none"> <li>▪ 1.1C - In all environments, organisms compete for vital resources. The linked and changing interactions of populations and the environment compose the total ecosystem.</li> <li>▪ 1.1d - The interdependence of organisms in an established ecosystem often results in approximate stability over hundreds and thousands of years. For example, as one population increases, it is held in check by one or more environmental factors or another species.</li> <li>▪ 1.1e - Ecosystems, like many other complex systems, tend to show cyclic changes around a state of approximate equilibrium.</li> <li>▪ 1.1f - Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of species and environmental changes can upset ecosystem stability.</li> </ul> </li> </ul> </li> <li>• Key Idea 6: Plants and animals depend on each other and their physical environment. <ul style="list-style-type: none"> <li>○ P.I. 6.1: Explain factors that limit growth of individuals and populations. <ul style="list-style-type: none"> <li>▪ 6.1f - Living organisms have the capacity to produce populations of unlimited size, but environments and resources are finite. This has profound effects on the interactions among organisms.</li> </ul> </li> </ul> </li> <li>• Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.</li> </ul>		
<b>Objectives:</b> <ol style="list-style-type: none"> <li>1. Students will understand that prey need predators like predators need prey, because they keep each other's populations stable.</li> <li>2. Students will understand that every population has a limit based on available resources called a carrying capacity.</li> <li>3. Students will be able to construct and interpret a predator-prey graph.</li> <li>4. Students will understand that humans have a significant impact on the environment, and even when humans have good intentions, they may do harm.</li> </ol>		
<b>Materials:</b> <ol style="list-style-type: none"> <li>1. Lesson of the Kaibab and Deer: Predation or Starvation worksheets (Muskopf, 2014). Retrieved from: <a href="http://www.biologycorner.com/worksheets/predator_pre_graphing.html">http://www.biologycorner.com/worksheets/predator_pre_graphing.html</a></li> <li>2. Group Processing Checklist (attached)</li> <li>3. Group Processing Questions (attached)</li> </ol>		
<b>Scaffold Suggestions:</b> <ul style="list-style-type: none"> <li>-Allow students, who have trouble speaking, to write down their thoughts during group work.</li> <li>-Teacher can scan various groups, and assist those that are having trouble communicating or cooperating.</li> <li>-Group low achieving students with high achieving students.</li> </ul>		

## Procedure:

### Anticipatory Set:

- Ask students what they know about predator – prey relationships.
- Get a discussion started by asking students if predators need prey, and then asking them if the prey need the predators.

### Body:

- Arrange students into groups of three.
- Hand each student a ‘Kaibab Plateau’ worksheet.
- Explain that each group must work together so that every member completes the sheet.
- Explain that one member from each group will be randomly selected to turn in their sheet. The grade for all three members of that group will be the grade of the selected individual. **A-4, B-1, C-3**
- Look for opportunities to teach interpersonal skills. **D-2**
- Next, hand out the ‘Predation or Starvation’ worksheet to each group.
- Instruct students to complete it.
- Explain that there will be a special activity for question 3.
  - Group members must discuss question 3 and come to an agreed opinion.
  - Each group member will be assigned a number of 1, 2 or 3.
  - The 1s from each group will get together, as well as the 2’s and the 3’s.
  - In these larger groups, each student will be responsible for sharing their group’s opinion and defending it. **A-4, B-1, C-3**
  - The teacher can look for opportunities to teach interpersonal skills when students are in the small groups and when they are in the large groups. **D-2**
- The worksheet will be graded individually for each student.

### Closure:

- Reserve at least 10 minutes for group processing. **B-3, C-4, D-3, E-1**
  - Hand out the ‘Group Processing Checklist’ and the group processing question sheets to each group.
  - The checklist should be completed first, then the group processing questions.
  - Encourage students to take their time, work together, and answer the questions as thoughtfully as possible. **E2, E3**

## Cooperative Components

- Positive Interdependence
  - A-4: Randomly selecting one member for each group to turn in their ‘Kaibab plateau’ worksheet will establish positive interdependence. The students will not know which member will be selected until they are finished. This means everyone in the group is going to have to do well. If one member works poorly or doesn’t participate, there will be a chance that his/her work will be graded and the other members of the group will share in the under achievement. So, students will be motivated to not let one students fall behind.
  - A-4: With the second worksheet, students will be encouraged to help each other since each individual will have to represent and defend the group opinion from question 3.
- Promotive Interaction
  - B-1: With the first worksheet, students will be motivated to promote the success of their peers since their own grade could depend on it.
  - B-1: For the second worksheet, students will be motivated to help their peers understand what is going on so that they can defend the group opinion during the ‘jigsaw’ activity.
  - B-3: The group processing exercise will have an encouragement component.
- Individual Accountability
  - C-3: During the first worksheet, any student of each group could be selected to be responsible for the grade of

	<p>the whole group. This puts pressure on each individual to do his/her best work.</p> <ul style="list-style-type: none"> <li>○ C-3: The second activity requires each student to have some responsibility for question 3. They need to get involved with the activity and be on the same page with the group so that they can properly represent the group in the large groups. This is 'jigsaw' type activity.</li> <li>○ C-4: There is a component in the group processing that will address student participation.</li> </ul> <ul style="list-style-type: none"> <li>● Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-2: As students work together on the first sheet, the teacher should look for effective or ineffective examples of peer communication and cooperation.</li> <li>○ D-2: Since there could be differences in opinions during the small groups and large groups, the teacher should look for examples of strong or weak interpersonal skills during this activity.</li> <li>○ D-3: The group processing exercise can help with interpersonal skills because it provides students and opportunity to recognize positive or negative interactions students made with each other.</li> </ul> </li> <li>● Group processing <ul style="list-style-type: none"> <li>○ E-1: 10 minutes must be reserved for the group processing exercise at the end of this lesson.</li> <li>○ E-2: Group processing questions are given to each student to discuss with group members.</li> <li>○ E-3: The 'group processing checklist' can be given first. This will help students to start thinking of how they and their group members did.</li> </ul> </li> </ul>
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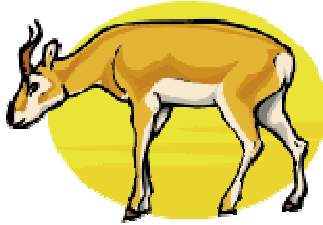
**Assessment:**

- Continually check in with groups and observe how they are doing or assist where needed.
- Assess the worksheets.
- Look over the group processing questions and the 'Group processing checklist' to assess how cooperative learning went.

## Lesson 2 Attachments

### Student Handout 1

# The Lesson of the Kaibab



Introduction: The environment may be altered by forces within the biotic community, as well as by relationships between organisms and the physical environment. The **carrying capacity** of an ecosystem is the maximum number of organisms that an area can support on a sustained basis. The density of a population may produce such profound changes in the environment that the environment becomes unsuitable for the survival of that species. For instance, overgrazing of land may make the land unable to support the grazing of animals that lived there.

#### Objectives:

- Graph data on the Kaibab deer population of Arizona from 1905 to 1939
- Determine factors responsible for the changing populations
- Determine the carrying capacity of the Kaibab Plateau

## Background

Before 1905, the deer on the Kaibab Plateau were estimated to number about 4000. The average carrying capacity of the range was then estimated to be about 30,000 deer. On November 28th, 1906, President Theodore Roosevelt created the Grand Canyon National Game Preserve to protect the "finest deer herd in America."

Unfortunately, by this time the Kaibab forest area had already been overgrazed by sheep, cattle, and horses. Most of the tall grasses had been eliminated. The first step to protect the deer was to ban all hunting. In addition, in 1907, The Forest Service tried to exterminate the predators of the deer. Between 1907 and 1939, 816 mountain lions, 20 wolves, 7388 coyotes and more than 500 bobcats were killed.

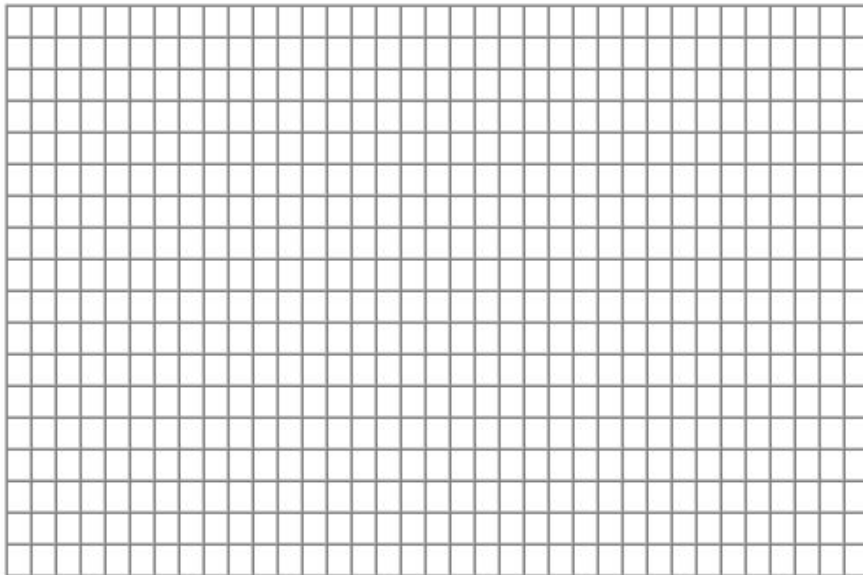
Signs that the deer population was out of control began to appear as early as 1920 - the range was beginning to deteriorate rapidly. The Forest Service reduced the number of livestock grazing permits. By 1923, the deer were reported to be on the verge of starvation and the range conditions were described as "deplorable."

The Kaibab Deer Investigating Committee recommended that all livestock not owned by local residents be removed immediately from the range and that the number of deer be cut in half as quickly as possible. Hunting was reopened, and during the fall of 1924, 675 deer were killed by hunters. However, these deer represented only one-tenth the number of deer that had been born that spring. Over the next two winters, it is estimated that 60,000 deer starved to death.

Today, the Arizona Game Commission carefully manages the Kaibab area with regulations geared to specific local needs. Hunting permits are issued to keep the deer in balance with their range. Predators are protected to help keep herds in balance with food supplies. Tragic winter losses can be checked by keeping the number of deer near the carrying capacity of the range.

## DATA

1. Graph the deer population data. Place time on the X axis and "number of deer" on the Y axis



DATA TABLE	
Year	Deer Population
1905	4,000
1910	9,000
1915	25,000
1920	65,000
1924	100,000
1925	60,000
1926	40,000
1927	37,000
1928	35,000
1929	30,000
1930	25,000
1931	20,000
1935	18,000
1939	10,000

## Analysis

1. During 1906 and 1907, what two methods did the Forest Service use to protect the Kaibab deer?

2. Were these methods successful? Use the data from your graph to support your answer.



3. Why do you suppose the population of deer declined in 1925, although the elimination of predators occurred?

4. Why do you think the deer population size in 1900 was 4,000 when it is estimated that the plateau has a carrying capacity of 30,000?

5. Based on these lessons, suggest what YOU would have done in the following years to manage deer herds.

1915:

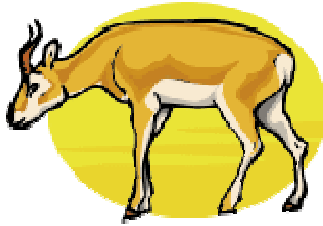
1926:

6. It is a criticism of many population ecologists that the pattern of population increase and subsequent crash of the deer population would have occurred even if the bounty had not been placed on the predators. Do you agree or disagree with this statement. Explain your reasoning.

7. What future management plans would you suggest for the Kaibab deer herd?

## Lesson 2: Student Handout 2

Name: \_\_\_\_\_ Date: \_\_\_\_\_



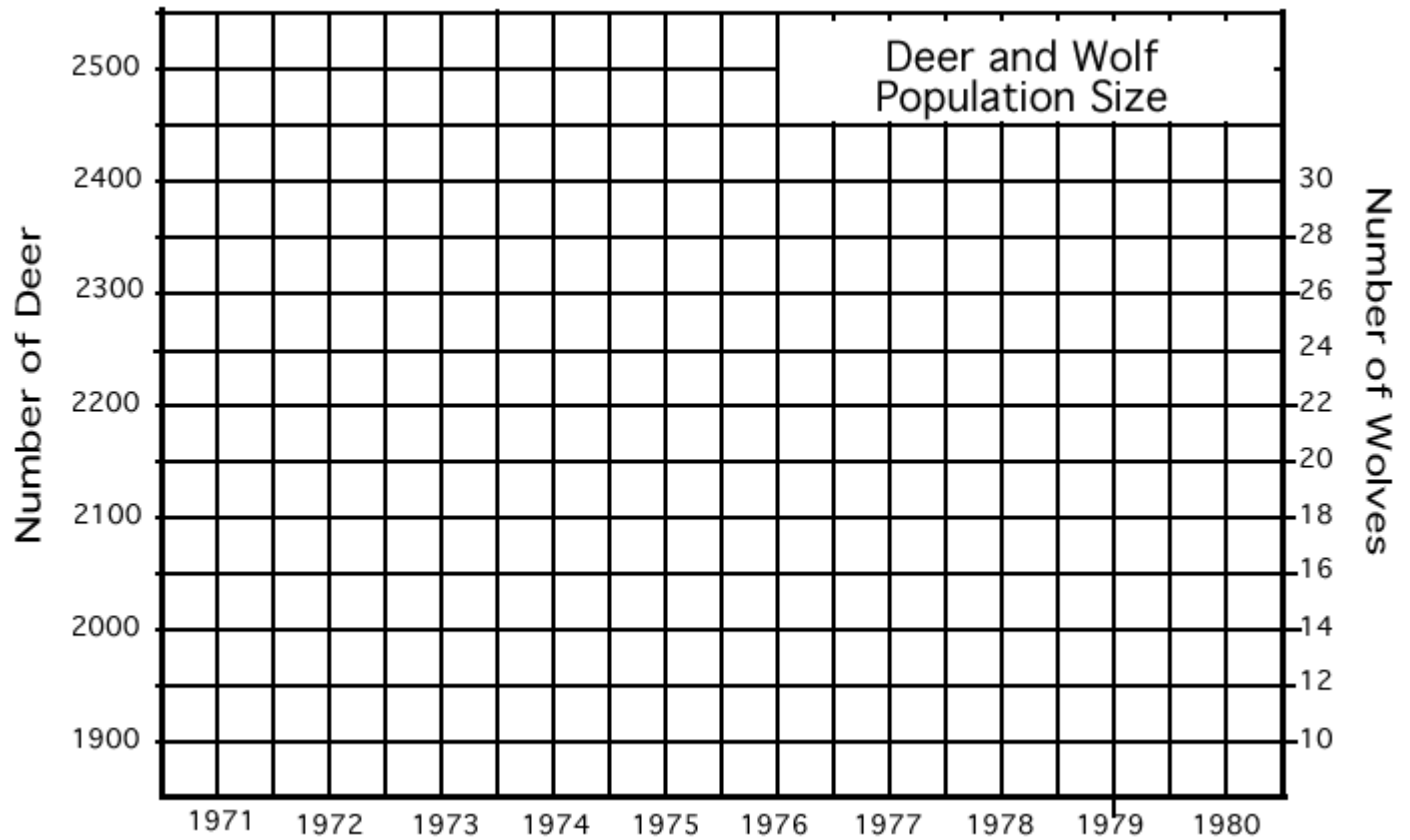
# Deer: Predation or Starvation

Introduction: In 1970 the deer population of an island forest reserve about 518 square kilometers in size was about 2000 animals. Although the island had excellent vegetation for feeding, the food supply obviously had limits. Thus the forest management personnel feared that overgrazing might lead to mass starvation. Since the area was too remote for hunters, the wildlife service decided to bring in natural predators to control the deer population. It was hoped that natural predation would keep the deer population from becoming too large and also increase the deer quality (or health), as predators often eliminate the weaker members of the herd. In 1971, ten wolves were flown into the island.

The results of this program are shown in the following table. The Population Change is the number of deer born minus the number of deer that died during that year. Fill out the last column for each year (the first has been calculated for you).

Year	Wolf Population	Deer Population	Deer Offspring	Predation	Starvation	Deer Population Change
1971	10	2,000	800	400	100	+300
1972	12	2,300	920	480	240	
1973	16	2,500	1,000	640	500	
1974	22	2,360	944	880	180	
1975	28	2,224	996	1,120	26	
1976	24	2,094	836	960	2	
1977	21	1,968	788	840	0	
1978	18	1,916	766	720	0	
1979	19	1,952	780	760	0	
1980	19	1,972	790	760	0	

1. Graph the deer and wolf populations on the graph below. Use one color to show deer populations and another color to show wolf populations.



Analysis

1. Describe what happened to the deer and wolf populations between 1971 and 1980.
2. What do you think would have happened to the deer on the island had wolves NOT been introduced?

3. Most biology textbooks describe that predators and prey exist in a balance. This "balance of nature" hypothesis has been criticized by some scientists because it suggests a relationship between predators and prey that is good and necessary. Opponents of this hypothesis propose the following questions:

*Why is death by predators more natural or "right" than death by starvation?*

*How does one determine when an ecosystem is in "balance"?*

*Do predators really kill only the old and sick prey? What evidence is there for this statement?*

What is your opinion of the balance of nature hypothesis? Would the deer on the island be better off, worse off, or about the same without the wolves. Defend your position.

## Lesson 2: Student Handout 3 – For Group Processing

### Group Processing Checklist

Name \_\_\_\_\_

Group Member Names \_\_\_\_\_

With your group members, decide which accomplishments you achieved and check yes or no accordingly. Also, complete the two statements at the bottom.

<b>Accomplishments</b>	<b>Yes</b>	<b>No</b>
We completed our task successfully.		
We were encouraging to each other.		
We were respectful towards each other.		
We all worked hard to complete the assignment		
Our biggest strength was...		
We all could work on improving...		

## Lesson 2: Student Handout 4 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 3 – DNA Translation

### Significance of Lesson

This lesson requires students to make their own prediction as opposed to direct instruction. This can be very difficult for students as they are accustomed to being given information to memorize. Cooperative learning can make this task achievable for all students.

With the cooperative components in place, students will be motivated to help their team members to succeed. Therefore, students who struggle with the independent thinking required to make a prediction will likely have a team mate who will help them. No student will get a ‘free ride’, however, as each one has to present the group prediction in front of the larger groups.

Science is not just about making predictions. Once a prediction is made, scientist must be able to present the prediction to others. Effective communication of an idea or thought is a useful skill in any profession including science (NEA, 2012). With the cooperative learning components, students are likely to communicate their predictions well as they will be supported by their group peers and critiqued by other peers.

<b>Grade:</b> High School/9th grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>● The majority of students should possess, at least, a 7<sup>th</sup> grade reading level.</li><li>● The majority of students should possess basic inter-personal skills.</li><li>● Students should have successfully completed 7<sup>th</sup> grade Living Environment course.</li><li>● Students should have successfully completed lessons on DNA structure, DNA replication, and DNA transcription.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>● Standard 4</li><li>● Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.<ul style="list-style-type: none"><li>○ P.I. 2.1: Explain how the structure and replication of genetic material result in offspring that resemble their parents.</li></ul></li></ul>		

- 2.1c - Hereditary information is contained in genes, located in the chromosomes of each cell. An inherited trait of an individual can be determined by one or by many genes, and a single gene can influence more than one trait. A human cell contains many thousands of different genes in its nucleus.
- 2.1f - In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular 'bases') and replicated by means of a template.
- 2.1g - Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
- 2.1i - The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acids in a specific sequence. This sequence influences the shape of the protein. The shape of the protein, in turn, determines its function.
- 2.1j - Offspring resemble their parents because they inherit similar genes that code for the production of proteins that form similar structures and perform similar functions.

#### **Objectives:**

1. Given a diagram of translation, students will be able to identify the ribosome, the tRNAs, the mRNA, the codons, the anticodons, and the amino acids in about 7 minutes.
2. Students will be able to define what a protein is, mainly that they are made up of amino acids, and that there are 20 different amino acids found in nature in about 5 minutes.
3. Students will be able to explain and/or draw out how you can get from DNA to protein in about 10 minutes.

#### **Materials:**

1. Transcription and translation animations found at  
[http://www-class.unl.edu/biochem/gp2/m\\_biology/animation/gene/gene\\_a2.html](http://www-class.unl.edu/biochem/gp2/m_biology/animation/gene/gene_a2.html)  
<http://www.johnkyrk.com/DNAtranscription.html>  
<http://www.johnkyrk.com/DNAtranslation.html>  
<http://learn.genetics.utah.edu/content/begin/dna/transcribe/>
2. Computer with projector
3. Whiteboard with markers
4. Peer assessment for group predictions (attached)
5. Peer evaluation form (attached)
6. Group Processing Questions (attached)

#### **Scaffold suggestions:**

- Allow students, who have trouble speaking, to write down their thoughts during group work.
- Teacher can scan various groups, and assist those that are having trouble communicating or cooperating.
- Students who are doing well in this topic can be grouped with students who are struggling with this topic.



## Procedure:

### Anticipatory Set: (5-10 minutes)

- The teacher should ask the class if anyone can describe transcription, and see what responses come out of it.
- Play the first transcription animation and see if there are any questions.
  - The point is to refresh the students on transcription, and see if there are any misunderstandings.
- The teacher should explain to the students that they will now learn about translation.

### Body: (55 – 65 minutes)

- Students should be placed into groups of three.
- Assign each group member a number of 1, 2 or 3.
- Give each group at least five minutes to come up with a prediction of how ribosomes, tRNA, and mRNA make protein.
- Explain to the students that each group member is responsible for explaining the group prediction to other students.
- Make sure students understand that each group member will be assessed by his/her peers when they present the group opinion to the large group.
  - The peers assessments for each group member will be averaged out to give a group grade for this activity.
- Once each group decides on their prediction, all number one students will group together, all number two students will group up and all number three students will group up.
- Make sure each student has enough peer assessments to evaluate each peer.
- Each student will share the prediction from the original groups with the larger group while the rest of the students complete the peer assessment. **A-4, C-3, B-1, D-2**
- Direct students to go back to their original groups and share anything interesting they found out from the larger groups.
- Now provide students with laptops or computers.
  - Each group of three can take about 15 - 20 minutes to go through the remaining three simulations and come up with a final explanation for how protein translation takes place.
  - Each student must write out their

## Cooperative Components

- Positive Interdependence
  - A-4: Students will become dependent on each other when they realize that each one of them is responsible for understanding the prediction of the whole group since they will each have to express the opinion in the large groups on their own.
  - A-2: By offering bonus points to each group for the translation explanation, there should be positive interdependence created between the three members. Each individual should realize that they are not going to obtain the bonus points just by participating themselves. Each student will have to make sure their group members are participating as well as themselves. The bonus points depend on all, not just one, doing well. and
- Promotive Interaction
  - B-1: If the jigsaw activity is affective, students should be motivated to encourage each other. The bonus points for the translation explanation should also result in promotive interaction. They should understand that their own success isn't enough, but that their group members need to succeed as well.
  - B-3: The group processing activities in the closure section will provide students the opportunity to reflect on how encouraging they were to each other.
- Individual Accountability
  - C-3: Since each student has to individually express the group ideas during the jigsaw activity, there will be a responsibility on each student to do their best. The group

<p>translation explanation and hand it in to the teacher.</p> <ul style="list-style-type: none"> <li>○ Explain that if all group member scores a 90% or higher on the explanation, that each member will receive 5 bonus points. <b>A-2, B-1</b></li> </ul> <p><b><u>Closure:</u> (10 – 15 minutes) E-1,E-2,E-3, B-3, C-4, D-3</b></p> <ul style="list-style-type: none"> <li>● Hand out ‘peer evaluation forms’ to each student. <ul style="list-style-type: none"> <li>○ Encourage students to talk to each other as they complete the forms.</li> </ul> </li> <li>● Give each group one copy of the ‘Group Processing Questions’. Encourage them to thoughtfully discuss the questions and give quality answers.</li> </ul>	<p>will not succeed unless each student participates.</p> <ul style="list-style-type: none"> <li>○ C-4: The group processing activities in the closure section provide students with the opportunity to reflect on how well each member participated and contributed to the group.</li> <li>● Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-2: Having students share ideas with larger groups can be a great opportunity to develop social skills. Students have to interact with peers in their group and come to an agreement about a prediction. Then they have to be able to leave the base group and go to a larger group of different peers and express themselves to them. To be able to do this efficiently, students must have strong social skills. When/if conflicts arise, the teacher can take the opportunity to show students how to interact professionally.</li> <li>○ D-3: The group processing activities in the closure section provide the students with the opportunity to reflect on how well they communicated with each other. They can decide if there are ways they can improve in this area.</li> </ul> </li> <li>● Group Processing <ul style="list-style-type: none"> <li>○ E-1: The closure section of this lesson is devoted to group processing. The ‘peer evaluation’ and the ‘group processing questions’ will cause students to look at how their group did and what they can do to improve.</li> <li>○ E-2: The ‘group processing questions’ will help students to think of things they and their peers did well and not so well.</li> <li>○ E-3: The ‘peer evaluation form’ will reinforce the group processing by getting them to think about how well they did in different aspects of the group activities. It should</li> </ul> </li> </ul>
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	prepare them for a meaningful discussion when they look over the 'group processing questions'.
<b>Assessment:</b> <ul style="list-style-type: none"><li>● Periodically ask if everyone understands what has been presented.</li><li>● Scan the class for students who are not paying attention or students who looked confused.</li><li>● Look over the 'peer evaluation forms' to see how students assessed each other, and get an idea of how well students cooperated.</li><li>● Look over the 'Group Processing Questions' to see how well students worked in their group, and how thoughtful they were about improving the next time</li><li>● Give a quiz next class with questions based on the objectives.</li><li>● Assign homework with questions based on the objectives.</li></ul>	

## Lesson 3 Attachments

### Student Handout 1 – For Presentations

#### Peer Assessment for Group Predictions

	Very Good 3	Satisfactory 2	Poor 1
Prediction is clearly expressed.			
Prediction makes sense.			
Prediction is creative and/or unique.			
Overall, how did the student do?			
Total = /12			

### Lesson 3: Student Handout 2 – For Group Processing

#### Peer Evaluation Form

Name \_\_\_\_\_

Group Member Names:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Directions: Use this form to rate yourself and your group members using the number scale. Add up the points at the bottom to get each total.

Ratings: 5=Perfect 4=very good 3=good enough 2=could be better 1=very poor

Attribute	You	Member 1	Member 2	Member 3
Contributed to the activity.				
Encouraged others.				
Carried out role responsibilities				
Communication Skills				
Professionalism				
TOTALS				

### **Lesson 3: Student Hand out 3 – For Group Processing**

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 4 – The Nature of Enzymes

### Significance of Lesson

While it gives some guidance, this lesson requires students to use inquiry to develop their own lab procedure and conclusions in an investigation of enzyme activity. Many labs in science education are full of step by step instruction. So, it can be difficult and frightening for students to complete a lab with less guidance. Individually, there are bound to be students who cannot complete this activity. Cooperative learning can be helpful in this area.

First of all, grouping students together makes it more likely that all students will succeed. Together, students can support each other as they try to figure out what to do. The cooperative components further ensure that each student in a group will share responsibility in this task. Each student must take on a role with a unique responsibility. Also, each student will have to complete the writing assignment at the end which summarizes the whole lab activity. This means that each individual has to understand what the group does and the conclusions they make.

<b>Grade:</b> High School/9th grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>● The majority of students should possess, at least, a 7<sup>th</sup> grade reading level.</li><li>● The majority of students should possess basic inter-personal skills.</li><li>● Students should have successfully completed a middle school life science course.</li><li>● Students should be introduced to enzymes before this lesson.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>● Standard 4</li><li>● Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.<ul style="list-style-type: none"><li>○ P.I. 5.1: Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.<ul style="list-style-type: none"><li>■ 5.1f - Biochemical processes, both breakdown and synthesis, are made possible by a large set of biological catalysts called enzymes. Enzymes can affect the rates of chemical change. The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature.</li></ul></li></ul></li></ul>		

<ul style="list-style-type: none"> <li>5.1g - Enzymes and other molecules, such as hormones, receptor molecules, and antibodies, have specific shapes that influence both how they function and how they interact with other molecules.</li> </ul>	
<b>Objectives:</b> <ol style="list-style-type: none"> <li>Students will know that enzymes are biological catalysts which make most chemical reactions, in living things, possible.</li> <li>Students will know that enzyme function is affected by heat, pH level, enzyme concentration and substrate concentration.</li> </ol>	
<b>Materials:</b> <ol style="list-style-type: none"> <li>Catalase Lab Packet (attached)</li> <li>Hydrogen peroxide</li> <li>Small petri dishes</li> <li>100 mL beakers</li> <li>Droppers</li> <li>Potato and apple pieces or any other organic tissue that will react with hydrogen peroxide</li> <li>Microwave</li> <li>Group processing checklist(attached)</li> <li>Group processing questions (attached)</li> </ol>	
<b>Scaffold suggestions:</b> <ul style="list-style-type: none"> <li>Allow students, who have trouble speaking, to write down their thoughts during group work.</li> <li>Teacher can scan various groups, and assist those that are having trouble communicating or cooperating.</li> <li>Role descriptions can be written out on cards to help students understand their responsibilities.</li> <li>Students who are strong in science can be grouped with students who struggle in science.</li> </ul>	
<b>Procedure:</b>  <u><i>Anticipatory Set: (5-10 minutes)</i></u> <ul style="list-style-type: none"> <li>Start a discussion and find out what students know by asking, “What are Enzymes?” and “Why do organisms need enzymes?”.</li> <li>Explain that Hydrogen peroxide is a compound produced in cells that is poisonous. Catalase is an enzyme that breaks down hydrogen peroxide into harmless hydrogen and oxygen.</li> <li>Let students know that they are going to explore the catalase enzyme.</li> </ul> <u><i>Body: (55 – 65 minutes)</i></u> <ul style="list-style-type: none"> <li>Split students into groups of three.</li> <li>Assign roles. <b>A-1, B-1</b></li> <li>Responsibilities of each member: <ul style="list-style-type: none"> <li>Complete each task in the lab packet.</li> <li>Observe what is happening during each task.</li> <li>Make a contribution to the group for each lab question.</li> <li>Complete the ‘Conclusion’ assignment.</li> </ul> </li> <li>Role responsibilities are as follows:<b>A-1, B-1, C-1</b></li> </ul>	<b>Cooperative Components</b> <ul style="list-style-type: none"> <li>Positive Interdependence <ul style="list-style-type: none"> <li>A-1: Three group roles are assigned in this activity. This will give each student a unique way to contribute to the group which will make each member dependent on the other. For example, everyone will have to depend on the recorder to write out the lab packet answers for a good grade.</li> <li>A-4: Averaging all three grades for the conclusion assignment, and giving each member the average of all three will motivate each group member to depend on each other to do well. Each student’s performance affects the whole group.</li> </ul> </li> <li>Promotive Interaction <ul style="list-style-type: none"> <li>B-1: Assigning roles and average the grades of the conclusion assignment should instill positive</li> </ul> </li> </ul>



- Decision maker – this student makes the final decision after a discussion. For example, after students discuss how to test for the effect of enzyme concentration, whether everyone agrees or not, it is up to the decision maker to tell the recorder how they will do it. The decision maker is especially important when all students in the group cannot come to the same conclusion.
- Recorder – this student is responsible for writing out any responses on behalf of the group. The recorder's lab packet, except for the conclusion, will be the only one collected and every group member's grade will come from it.
- Ambassador – this student is responsible for making sure everyone in the group is contributing to the activity, and that they are all respectful towards one another. He/she should encourage other students. If there is a problem related to student cooperation or participation, the ambassador must inform the teacher. **B-2, C-2, D-1**
- Make sure students understand that the only lab packet corrected and graded will be the recorder's. Also, make sure they understand that they are all responsible for completing the 'conclusion' assignment at the end.
- Explain to the students that the grade for the 'conclusion' assignment will be determined by grading each group members, and then taking an average of the three. That average will be every group member's grade. **A-4, B-1, C-3**
- Make sure each student has a lab packet, and have them start the tasks.
- You may need to demonstrate all or some of the tasks to the class.
- Spend time observing various groups, and look for efficient or inefficient examples of social interaction that can be shared with the class. **D-2**
- Make sure they get through all of the tasks with 10 – 15 minutes left for group processing.
- The closure assignment can be done for homework.

Closure: (10 – 15 minutes) **E-1, E-2, E-3, B-3, C-4,**

interdependence. Therefore, students will be motivated to encourage each other to do well as it is in their best interest.

- B-2: One purpose of the ambassador role is to promote encouragement between group members.
- B-3: Group processing will allow student to evaluate how encouraging they and their group mates were.
- Individual Accountability
  - C-1: Each group member is given a role. This way, they each have something they have to do for the success of the group. If one student does not carry out his/her responsibilities, the group cannot succeed.
  - C-2: One purpose of the ambassador role is to have a student who holds the others individually accountable. The ambassador should also hold him/herself accountable.
  - C-3: By giving each student the average grade of all three conclusion assignments, each individual student will feel pressure to do his/her best for the benefit of the whole group.
  - C-4: Group processing is a great opportunity for students to discuss how each member contributed to the group. They can think of ways to do better next time, and learn from any mistakes or successes they made this time.
- Interpersonal Skills
  - D-1: The ambassador requires one group member to make sure students are communicating and interacting appropriately. This student is also required to inform the teacher if students are not getting along.
  - D-2: Once the activity begins, the teacher should travel from group to group looking for

**D-3**

- Reserve the rest of class time for group processing.
  - Hand out the 'Group Processing Checklist' and the 'group processing question' sheets to each group.
  - The checklist should be completed first, then the group processing questions.
  - Encourage students to take their time, work together, and answer the questions as thoughtfully as possible.

positive or negative examples of social interaction. If it's a good learning opportunity, the teacher should explain what happened to the whole class.

- D-3: Providing time for group processing will give the students a great opportunity to examine how well they did with interpersonal skills. This will help them improve when they perform future cooperative activities.

- Group Processing

- E-1: Time is reserved at the end of this activity for group processing. This time is extremely valuable as it will help students to improve next time they take part in a cooperative learning activity.
- E-2: The group processing questions guide students to discussing what went well, what went wrong, and how they can improve next time.
- E-3: The group processing checklist provides reinforcement for group processing. It is a quick way for students to think about their own performance, as well as that of their peers. It should help them think about how to answer the group processing questions.

**Assessments:**

- Periodically ask if everyone understands what has been presented
- scan the class for students who are not paying attention or students who looked confused
- Look over the 'Group processing checklists' and the 'group processing questions' to get an idea of how well group interactions went.

- give a quiz next class with questions based on the objectives
- assign conclusion write up for homework, and assess the completed write ups for understanding of the lab.

## Lesson 4 Attachments

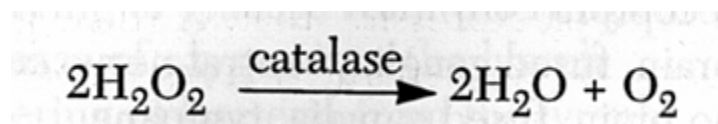
### Student Handout 1

Name: \_\_\_\_\_

### Catalase Enzyme Lab!!

Did you know your cells are making poison all of the time! Hydrogen peroxide is the byproduct of many chemical reactions. So how do you all go on living?

The enzyme catalase keeps us safe by breaking down hydrogen peroxide into harmless water and oxygen!!



Where can we find catalase?

We have apple pieces and potato pieces. How can we test them for the presence of the enzyme catalase?

Put a piece of apple in one petri dish, and a piece of potato in another dish. Use a pipette to submerge them with  $\text{H}_2\text{O}_2$ .

Is there catalase in the apple? How do you know?

Is there catalase in the potato? How do you know?

**How does Enzyme concentration affect the reaction?**

What do you have to do to test for enzyme concentration?

Explain your procedure in testing for enzyme concentration.

Does the enzyme concentration affect the reaction? How do you know?

**How does substrate concentration affect the reaction?**

What is the substrate?

How do you test the effect of substrate concentration?

Explain your procedure.

Does substrate concentration affect the reaction? How do you know?

**How does pH level affect the reaction?**

Predict what a lower (more acidic) pH level will do to the catalase reaction.

Use lemon juice to see how the reaction of catalase is affected by lower pH.

Does lower pH affect the reaction?

How do you know? Explain how you tested for pH.

### **How does heat affect the reaction?**

Predict how exposing the catalase to extreme heat will affect the reaction.

Take some potato or apple pieces to the microwave and cook them for 30 seconds to a minute. Now use  $\text{H}_2\text{O}_2$  on the cooked pieces and see what happens.

How was the reaction affected? How do you know?

### **Conclusion**

Write a summary of this lab: You are a researcher, and you need to report what you did in the lab today. Explain what catalase is and what it does. Why is it important? Write about what you did with apples and potatoes to test for catalase. What were the factors that you tested, and how did each affect the reaction? End the report by describing some interesting things you learned today. Each individual needs to complete this on a separate sheet of paper. (A typed write up is preferable).



## Lesson 4: Student Handout 2 – For Group Processing

### Group Processing Checklist

Name \_\_\_\_\_

Group Member Names \_\_\_\_\_

With your group members, decide which accomplishments you achieved and check yes or no accordingly. Also, complete the two statements at the bottom.

<b>Accomplishments</b>	<b>Yes</b>	<b>No</b>
We completed our task successfully.		
We were encouraging to each other.		
We were respectful towards each other.		
We all worked hard to complete the assignment		
Our biggest strength was...		
We all could work on improving...		

## Lesson 4: Student Handout 3 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 5 – DNA Replication, Transcription and Translation

### Significance of Lesson

Cooperative learning allows all students to learn about the central dogma of the study of DNA. The topic of this lesson is one that some students understand easily while others struggle. With the cooperative components in place, the teacher can assign the roles to each group member based on how well each student understands DNA. With cooperative learning, students will be motivated to help each other do well, so that students who understand this topic well, will help the others to succeed.

In addition, this lesson, with the cooperative components in place, gives students an opportunity to evaluate and communicate information. Students will evaluate information by determining the amino acid sequence from a DNA strand. Then students must present the information to the rest of class with an oral presentation. The 8<sup>th</sup> practice within the Next Generation Science Standards is, ‘Obtaining, Evaluating and Communicating Information’. It states that students should be able to interpret scientific information, and communicate information to others through writing, illustrations or oral presentations (National Research Council, 2012).

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<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• The majority of students should possess, at least a 7<sup>th</sup> grade reading level.</li><li>• The majority of students should possess basic inter-personal skills.</li><li>• Students should have successfully completed a middle school life science course.</li><li>• Students should have learned about DNA structure, DNA replication, DNA transcription and RNA translation.</li></ul>		

**State Standards:**

- Standard 4
- Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.
  - P.I. 2.1: Explain how the structure and replication of genetic material result in offspring that resemble their parents.
    - 2.1f - In all organisms, the coded instructions for specifying the characteristics of the organism are carried in DNA, a large molecule formed from subunits arranged in a sequence with bases of four kinds (represented by A, G, C, and T). The chemical and structural properties of DNA are the basis for how the genetic information that underlies heredity is both encoded in genes (as a string of molecular “bases”) and replicated by means of a template.
    - 2.1g - Cells store and use coded information. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.
    - 2.1i - The work of the cell is carried out by the many different types of molecules it assembles, mostly proteins. Protein molecules are long, usually folded chains made from 20 different kinds of amino acids in a specific sequence. This sequence influences the shape of the protein. The shape of the protein, in turn, determines its function.

**Objectives:**

1. Students will be able to determine the complimentary DNA strand when given a DNA sequence.
2. When given a coding dna sequence, students will be able to determine the complimentary mRNA sequence.
3. When given a mRNA sequence, students will be able to use the genetic code to determine the resulting amino acid sequence.

**Materials:**

1. Gene to Protein investigation packet (attached)(Each group should get a packet with a different DNA strand)
2. Peer Evaluation Form (attached)
3. Group Processing Questions (attached)

**Scaffold Suggestions:**

- Try to assign groups so that stronger students are working with weaker students.
- Make sure students who struggle with this topic are assigned the ‘replicator’ role as it is easier than the other roles. With that in mind, make sure the student who are the most comfortable with this topic are assigned the ‘Translator’ role. Students who are average can be assigned the ‘transcriber’ role.

**Procedure:****Anticipatory Set: (5-10 minutes)**

- Ask students how a gene goes from

**Cooperative Components:**

- Positive Interdependence
  - A-1: Each student is given their

<p>DNA to protein and see what they know.</p> <ul style="list-style-type: none"> <li>• Explain to the students that they are going to get together in groups to take a DNA strand from DNA all the way to a protein.</li> </ul> <p><b>Body: (50 – 60 minutes)</b></p> <ul style="list-style-type: none"> <li>• Ask students to raise their hands if they are comfortable using the genetic code to translate RNA to amino acids.</li> <li>• Pick a third of the class to be the ‘translators’. <b>A-1, B-1, C-1</b> <ul style="list-style-type: none"> <li>○ The translators will have to take an mRNA strand and use the Genetic code to determine the amino acid sequence.</li> </ul> </li> <li>• Of the remaining students, determine who is the best at transcribing DNA to RNA. Assign a ‘transcriber’ to work with each ‘translator’. <b>A-1, B-1, C-1</b> <ul style="list-style-type: none"> <li>○ The ‘transcriber’ must be able to look at a DNA sequence and determine the mRNA sequence that would be transcribed from it.</li> </ul> </li> <li>• The remaining students will be the ‘replicators’. <b>A-1, B-1, C-1</b> <ul style="list-style-type: none"> <li>○ ‘Replicators’ must be able to look at a DNA strand and determine the sequence of the complimentary strand.</li> </ul> </li> <li>• Every student in the class should now be in a group of 3 with one ‘replicator’, one ‘transcriber’ and one ‘translator’. <b>A-1, B-1, C-1</b></li> <li>• Hand out the ‘DNA to Protein’ packet to each student. <ul style="list-style-type: none"> <li>○ Make sure each group receives packets with different starting DNA sequences in Step 1.</li> </ul> </li> <li>• Explain to the class, that step 1 must be done by the ‘replicators’, step 2 must be done by the ‘transcribers’, and step 3 must be done by the ‘translators’. <b>A-1, B-1, C-1</b></li> <li>• Explain to the class that once they find</li> </ul>	<p>own role for this activity. One student must replicate the DNA strand and give the presentation at the end. Another student must transcribe the DNA strand. A third student is responsible for translating the mRNA strand. This should instill a sense of interdependence between group members.</p> <ul style="list-style-type: none"> <li>○ A-4: A packet will be randomly selected from on member of each group. This will motivate students to make sure they each are completing their own packets accurately. They will also depend on their peers to complete their packets accurately as well. <ul style="list-style-type: none"> <li>▪ There will also be interdependence created as the group will be counting on the presenter to do a good job. Students should be encouraged to support their presenter as much as possible.</li> </ul> </li> <li>• Promotive Interaction <ul style="list-style-type: none"> <li>○ B-1: Positive interdependence should be well established by the role assignments(<b>A-1</b>) and the packet assessments(<b>A-4</b>). Since the group members have to depend on each other to do well for success, they will be motivated to encourage one another.</li> <li>○ B-3: There will be time set aside for group processing after the activity. This will help students to improve promotive interaction next time they participate in a cooperative learning activity.</li> </ul> </li> <li>• Individual Accountability</li> </ul>
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<p>out which protein they have, there will be a pretend science conference.</p> <ul style="list-style-type: none"> <li>○ For the conference, each group must present to the class what they did and what protein they found. Then they need to explain the function of their protein.</li> <li>○ Since the ‘replicator’ students had the easiest jobs, they need to be the presenters for their groups. <b>A-1, A-4, B-1, C-1, C-3</b></li> <li>○ These mini presentations will be assessed by the rest of the class.</li> </ul> <ul style="list-style-type: none"> <li>● Give students 20 to 30 minutes to complete the packets and prepare for the mini presentations. <ul style="list-style-type: none"> <li>○ As students work on the packet, look for examples of effective peer interactions and poor peer interactions. Use examples to teach students how to communicate effectively and professionally. <b>D-2</b></li> </ul> </li> <li>● Grades determination: <ul style="list-style-type: none"> <li>○ A packet will be graded from one randomly selected group member of each group. (So each member must make sure they have completed the packet correctly)<b>A-4, B-1, C-3</b></li> <li>○ The mini presentation will be graded based on the peer assessments. <b>A-4, B-1, C-3</b></li> </ul> </li> </ul> <p><u>Closure:</u> <b>(10 – 15 minutes)B-3, C-4, D-3, E-1</b></p> <ul style="list-style-type: none"> <li>● Reserve the rest of class time(At least 10 minutes) for group processing. <ul style="list-style-type: none"> <li>○ Hand out the ‘Peer Evaluation Forms’ to each student, and the group processing question sheets to each group.<b>E-2, E-3</b></li> <li>○ The evaluation forms should be completed first, then the group processing questions.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>○ C-1: By assigning three different roles, each student has to make an individual contribution for the group to succeed. No one group member can do everything him/herself.</li> <li>○ C-3: <b>A-4</b> is clearly established in this activity. This will put pressure on each individual to do his/her best. They can’t expect the other group members to do everything.</li> <li>○ C-4: There will be time after the activity for group processing. Students can discuss how well each individual contributed to group success. This will help them do better on future cooperative activities.</li> </ul> <ul style="list-style-type: none"> <li>● Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-2: As students work on the packet, the teacher has an opportunity to look for examples of high quality interpersonal skills and low quality interpersonal skills.</li> <li>○ D-3: There will be time after the activity for group processing. Students can discuss how well they each did with interpersonal skills. This will help them improve for future cooperative learning activities.</li> </ul> </li> <li>● Group Processing <ul style="list-style-type: none"> <li>○ E-1: At least 10 minutes will be reserved after the activity for group processing.</li> <li>○ E-2: The group processing questions will guide students in discussing what when well, what went poorly and what they should do differently next time.</li> <li>○ E-3: The ‘Peer Evaluation Form’ is a quick assessment that will get students to think about what they did well and not so</li> </ul> </li> </ul>
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<ul style="list-style-type: none"> <li>• Encourage students to take their time, work together, and answer the questions as thoughtfully as possible</li> </ul>	<p>well. This will be a good reinforcement for group processing. It should be done first as it can work like a ‘warm-up’ for group processing.</p>
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>• Check in with groups and observe how they are doing during the activity.</li> <li>• Assess the packets after the lesson.</li> <li>• Assess the mini-presentations, and use the peer assessments to help.</li> <li>• Read over the ‘Peer Evaluation Forms’ to see how students evaluated themselves and their teammates.</li> <li>• Look over the ‘group processing questions’ to see how students thought they did, and how much thought they put into improving themselves in the future.</li> </ul>	

## Lesson 5 Attachments

### Student Handout 1

Names:

#### Gene to RNA to Protein investigation

Directions: You are a team of geneticists. You are working for a research facility that is trying to identify every gene in the genome of an animal. Your mission is to take an unknown gene and determine what protein it codes for. Once you find it, you must present your information, at the research meeting, to all your fellow scientists.

Step1: Take the DNA sequence below, and write out its complimentary strand.

ATGCATGCATAAGGCGTTCCATAA

Step 2: Take the resulting sequence and transcribe the RNA sequence.

Step 3: With the resulting RNA strand, use the genetic code to translate it into an amino acid sequence or protein.

Step 4: Look on the back to see what protein you discovered!



Met-Phe-Leu-Ser-Leu-Pro-Lys = Sucrase

You found Sucrase! This is an enzyme that helps break down sugar (sucrose) in an animal's digestive system.

Met-Gly-Arg-Glu-Ala-Ile-Ser = Pepsin

You found Pepsin! Pepsin is an enzyme that exists in an animal stomach. It helps break down proteins for digestion.

Met-Ala-Thr-Pro-Ser-Asn-Arg = Insulin

You found Insulin! Insulin is a hormone that is produced in the pancreas of animals. It helps lower the blood sugar level in animals when it gets too high.

Met-Tyr-His-Gln-Asn-Lys-Asp = Cytoplasmic Receptor

You found a cytoplasmic receptor protein! These proteins are found inside animal cells. They are responsible for beginning a metabolic process, inside the cell, when a hormone enters and gives it the signal.

Met-Gly-Thr-Ser-Asn-Arg-Lys = Cell membrane Receptor

You found a cell membrane receptor protein! They are found on the cell membrane of animal cells. Cell membrane receptor proteins are responsible for beginning a metabolic process in the cell when triggered by a hormone outside of the cell.

## Lesson 5: Student Handout 2

### The Genetic Code

		Second letter				Third letter
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop UGG Trp	
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	
	A	AUU } AUC } Ile AUA } AUG Met	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	
	G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	

## Lesson 5: Student Handout 3 – For Presentations

### Peer Assessment for Mini-Presentations

	Very Good 3	Satisfactory 2	Poor 1
Procedure is clearly expressed.			
The resulting protein makes sense.			
The protein is clearly identified and described.			
Overall, how did the student do?			
Total = /12			

## Lesson 5: Student Handout 4 – For Group Processing

### Peer Evaluation Form

Name \_\_\_\_\_

Group Member Names:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Directions: Use this form to rate yourself and your group members using the number scale. Add up the points at the bottom to get each total.

Ratings: 5=Perfect 4=very good 3=good enough 2=could be better 1=very poor

Attribute	You	Member 1	Member 2	Member 3
Contributed to the activity.				
Encouraged others.				
Carried out role responsibilities				
Communication Skills				
Professionalism				
TOTALS				

## Lesson 5: Student Handout 5 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 6 – Mitosis

### Significance of Lesson

This lesson is designed to allow students to observe mitosis and draw their own conclusions as to what part of the plant it takes place in and what that means. The conclusion might not be so clear to every student. With the cooperative components in place, students are more likely to come to the right conclusion. Positive interdependence will give student the motivation to help each other achieve understanding. Individual accountability will ensure that each member gets involved in the activity and learns something.

<b>Grade:</b> High School/ 9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• Students should possess a 7<sup>th</sup> grade reading level or higher.</li><li>• Students should possess basic inter-personal skills.</li><li>• Students should have successfully completed a middle school life science course.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>• Standard 4</li><li>• Key Idea 1: Living things are both similar to and different from each other and from nonliving things.<ul style="list-style-type: none"><li>○ P.I. 1.2: Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).<ul style="list-style-type: none"><li>▪ 1.2a: Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.</li><li>▪ 1.2f: Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and work together.</li></ul></li></ul></li><li>• Key Idea 4: The continuity of life is sustained through reproduction and development.<ul style="list-style-type: none"><li>○ P.I. 4.1: Explain how organisms, including humans, reproduce their own kind.<ul style="list-style-type: none"><li>▪ 4.1a: Reproduction and development are necessary for the continuation of any species.</li><li>▪ 4.1b: Some organisms reproduce asexually with all the genetic information coming from one parent. Other organisms reproduce sexually with half the genetic information typically contributed by each parent. Cloning is the production of identical genetic copies.</li></ul></li></ul></li></ul>		

<ul style="list-style-type: none"> <li>4.1d: The zygote may divide by mitosis and differentiate to form the specialized cells, tissues, and organs of multicellular organisms.</li> </ul>	
<b>Objectives:</b> <ol style="list-style-type: none"> <li>Students will understand that mitosis is asexual reproduction for single cells as well as growth and development for multicellular organisms.</li> <li>Students will understand that mitosis takes place mostly where there is growth in a multicellular organism.</li> <li>Students will be able to recognize cells in interphase versus cells undergoing mitosis when viewing an onion root slide in a microscope.</li> </ol>	
<b>Materials:</b> <ol style="list-style-type: none"> <li>Mitosis Lab (attached)</li> <li>Microscopes</li> <li>Onion Root Slides</li> <li>Cooperative Learning Rubric (attached)</li> <li>Group Processing Questions (attached)</li> </ol>	
<b>Scaffold Suggestions:</b> <ul style="list-style-type: none"> <li>Print out description for each role which can be provided for students to make their responsibilities more clear to them.</li> <li>If a student is struggling with this material or the course in general, make sure they are in a group with students who are doing very well in the course.</li> </ul>	
<b>Procedure:</b> <u>Anticipatory Set:(5 – 10 minutes)</u> <ul style="list-style-type: none"> <li>Ask students what Mitosis is and see what they know. Make sure they know that Mitosis is the dividing of one cell into two exact copies.</li> <li>Ask students why mitosis would be important for multicellular organisms like plants and animals. Discuss for a few minutes, but don't give them any answers.</li> </ul> <u>Body:(50 – 60 minutes)</u> <ul style="list-style-type: none"> <li>Hand out the lab packet to each student.</li> <li>Split students into group of three.</li> <li>Each student should be assigned a different role. <b>A-1, B-1, C-1</b> <ul style="list-style-type: none"> <li>Roles are as follows: <ul style="list-style-type: none"> <li>Decision maker – this student makes the final decision after a discussion. For example, after the members of the group discuss where in a plant</li> </ul> </li> </ul> </li> </ul>	<b>Cooperative Components:</b> <ul style="list-style-type: none"> <li>Positive Interdependence <ul style="list-style-type: none"> <li>A-1: There are three well defined roles in this activity. Each student in the group will have to depend on each other to fulfill their roles for the group to succeed.</li> <li>A-2: 5 bonus points, towards a future exam, will be rewarded to each member of a group if they score a 90% or higher on the lab packet. This should motivate the ambassador and the decision maker to work with the recorder to get the best grade possible since it makes them more dependent on the recorder.</li> </ul> </li> <li>Promotive Interaction <ul style="list-style-type: none"> <li>B-1: Positive interdependence should be well established with both <b>A-1</b></li> </ul> </li> </ul>

<p>mitosis will most likely occur, whether there is agreement or not, the decision maker must decide on the group's final answer.</p> <ul style="list-style-type: none"> <li>▪ Recorder – this student is responsible for writing out any responses on behalf of the group.</li> <li>▪ Ambassador – this students is responsible for make sure each member is fulfilling his/her role and contributing to the activity. The ambassador should also make sure that everyone is respectful and encouraging to each other. If there is a problem related to student cooperation or participation, the ambassador must inform the teacher. <b>B-2, C-2, D-1</b></li> </ul> <ul style="list-style-type: none"> <li>○ All students are responsible for contributing to the activity.</li> </ul> <ul style="list-style-type: none"> <li>• Let students know that just one packet will be collected from each group. The 'recorder' is responsible for filling out the packet that will be collected. <ul style="list-style-type: none"> <li>○ Explain that every packet with a grade of 90% or higher will result in 5 bonus points for each group member towards their next class exam. <b>A-2, B-1</b></li> </ul> </li> <li>• Make sure students work together to come up with the best answers they can for the 'pre-questions'.</li> <li>• Make sure each group has at least one microscope with an onion root slide.</li> <li>• Give students about 30 minutes to complete the lab activity. <ul style="list-style-type: none"> <li>○ Observe different groups to see if they need any assistance. Also, look for examples of effective</li> </ul> </li> </ul>	<p>and <b>A-2</b>. Therefore, students should be motivated to encourage each other.</p> <ul style="list-style-type: none"> <li>○ B-2: One responsibility of the ambassador is to encourage his/her peers. This should help with promotive interaction.</li> <li>○ B-3: Time will be set aside for group processing. This will give the students a chance to reflect on how encouraging they were, and if they should be more encouraging next time.</li> </ul> <ul style="list-style-type: none"> <li>• Individual Accountability <ul style="list-style-type: none"> <li>○ C-1: With unique roles, each student has their own specific responsibilities. This makes it difficult for an individual to do nothing during the activity.</li> <li>○ C-2: A responsibility of the 'ambassador' is to make sure each student, including him/herself is doing his/her fair share.</li> <li>○ C-4: There will be time set aside for group processing. This gives students a chance to discuss how much each of them contributed to the activity. If some students didn't contribute enough, they can think of ways to do better next time.</li> </ul> </li> <li>• Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-1: A responsibility of the 'ambassador' is to let the teacher know if there are negative interactions between two group members. This way the teacher can be sure to intervene when there is an issue.</li> <li>○ D-2: When students are working on the lab activity,</li> </ul> </li> </ul>
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<p>interpersonal skills and ineffective interpersonal skills that can be pointed out to the whole class. <b>D-2</b></p> <ul style="list-style-type: none"> <li>• Give students about 10 minutes to do the questions at the end of the lab.</li> <li>• Collect one lab packet from each group.</li> </ul> <p><b><u>Closure:</u> (10-15 minutes)B-3, C-4, D-3, E-1</b></p> <ul style="list-style-type: none"> <li>• Reserve at least 10 minutes for group processing.</li> <li>• Give each student two “Cooperative Learning Rubrics” and have them complete them as honestly as possible. <b>E-3</b></li> <li>• Hand out the ‘Group Processing Questions’ and encourage each group to discuss these before answering them. <b>E-2</b></li> </ul>	<p>the teacher has opportunity to see how students are interacting in their group. The teacher can look for examples of effective or ineffective communications or interactions between students. Examples can be used to teach the whole class about interpersonal skills.</p> <ul style="list-style-type: none"> <li>○ D-3: Time is set aside at the end of this activity for group processing. This will allow students to reflect and discuss how well they interacted with each other and where they could improve. This will help them learn from mistakes or successes as they do more cooperative learning activities in the future.</li> <li>• Group processing <ul style="list-style-type: none"> <li>○ E-1: At least 10 minutes will be set aside at the end of this lesson for group processing. This will give students an opportunity to reflect on and discuss how well they worked together.</li> <li>○ E-2: The ‘group processing questions’ are designed to guide students in discussing what went well, what went poorly, and what they should do differently next time.</li> <li>○ E-3: The ‘cooperative learning rubric’ is a peer assessment that will reinforce group processing as it will help students to think about how their peers did during the activity.</li> </ul> </li> </ul>
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>• Check in with groups and observe how they are doing during the activity.</li> <li>• Assess the packets after the lesson.</li> <li>• Read over the ‘Cooperative Learning Rubrics’ to see how students evaluated their</li> </ul>	

teammates.

- Look over the group processing questions to see how students thought they did, and how much thought they put into improving themselves in the future.

## Lesson 6 Attachments

### Student Handout 1

Name: \_\_\_\_\_

### Mitosis Lab

Purpose: To recognize mitosis in real cells, and to understand where mitosis takes place in plants.

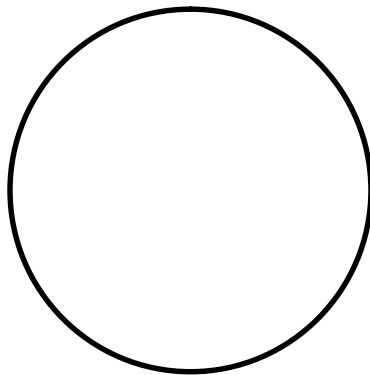
Pre-Questions: Answer these as completely as possible.

1. Why do cells undergo mitosis?
2. How is mitosis significant for multicellular organisms?
3. In what parts of an onion plant is mitosis going to occur?

Procedure:

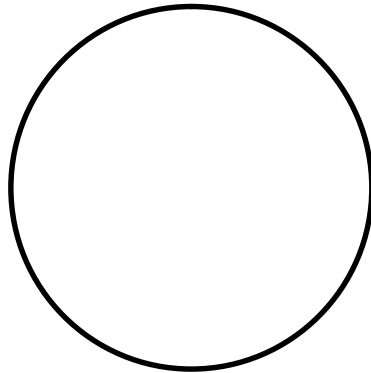
1. Place an onion root slide on your microscope stage, and develop a good view of the cells.

Look for a cell that is in interphase, and draw it below.



At what part of the onion root was that cell? Was it close to the tip or close to the top?

2. Look for a cell that is going through mitosis and draw it below.



What phase is the cell in (prophase, metaphase, anaphase or telophase)?

How do you know?

3. Find a spot toward the top of the onion root, and record the number of cells that fit in your viewer. Then record how many are in mitosis.

Total cell number:

Mitosis cell number:

Divide the mitosis number by the total cell number, then multiply that by 100 to get the percentage of mitosis.

Percentage of Mitosis cells:

4. Find a spot in the tip of the onion root and repeat step 3.

Total cell number:

Mitosis cell number:

Percentage of mitosis cells:

Questions:

1. In which spot did you find a higher mitosis percentage?
  
  
  
  
  
  
  
  
  
  
2. Why do you think there is a higher percentage of mitosis there?
  
  
  
  
  
  
  
  
  
  
3. What would happen if the onion plant cells could no longer undergo mitosis?
  
  
  
  
  
  
  
  
  
  
4. Why do human cells have to undergo mitosis?
  
  
  
  
  
  
  
  
  
  
5. What type of human cells do you think undergo the most mitosis? Why?

## Lesson 6: Student Handout 2 – For Group Processing

### Cooperative Learning Rubric

Name: \_\_\_\_\_

Name of group member being assessed: \_\_\_\_\_

Category	4	3	2	1
<b>Contribution to the Task</b>	Went above and beyond. Not only completed his/her own part, but helped each other group member complete theirs.	Did his/her fair share of the task. Also provided some assistance to other group members.	Did less than his/her fair share of the task. Did not provide any assistance to the other group members.	Did almost nothing towards the completion of the task. Provided no assistance to the rest of the group.
<b>Promoting the Group</b>	Was always very encouraging. Displayed a very positive attitude, and helped motivate the other group members.	Was encouraging most of the time. Had a positive attitude most of the time.	Provided a little encouragement. Did not usually have a positive attitude.	Had a negative attitude most of the time. Provided no encouragement
<b>Inter-personal Skills</b>	Communicated very well. Was very easy to understand. Always respectful to other students.	Was understandable most of the time. Was respectful to other students most of the time.	Was understandable sometimes. Was respectful to other students sometimes.	Did not communicate or was not understandable. Was not respectful to others.
<b>Role Responsibilities</b>	Completely fulfilled his/her role responsibilities. Helped other students to carry out their roles.	Fulfilled most of his/her role responsibilities.	Fulfilled some of his/her role responsibilities.	Did not fulfill his/her role responsibilities.
<b>TOTAL SCORE:</b>  _____	Comments:			

## Lesson 6: Student Handout 3 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 7 – Cellular Respiration

### Significance of Lesson

This lesson gives students a lot of freedom to investigate cellular respiration with yeast. Many students have trouble with independent learning activities like this because they are afraid of doing it wrong. The cooperative learning components ensure that all students will engage in this activity with confidence.

Each student is given their own unique part to play at the beginning which gives each individual some responsibility. Then the group members must work together to figure out what sweetener to use and how to test it. Every member has to achieve the same goal, so they will be motivated to make rational arguments. Students should be motivated to support each other through every part of this activity so they can gain maximum understanding of the content.

<b>Grade:</b> High School/ 9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> One 40 minute period and two 80 minutes periods
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• Students should possess a 7<sup>th</sup> grade minimum reading level.</li><li>• Students should possess basic inter-personal skills.</li><li>• Students should have successfully completed a middle school life science course.</li><li>• Students should be introduced to the concept of cellular respiration before this activity.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>• Standard 4</li><li>• Key Idea 1: Living things are both similar to and different from each other and from nonliving things.<ul style="list-style-type: none"><li>○ P.I. 1.2: Describe and explain the structures and functions of the human body at different organizational levels (e.g., systems, tissues, cells, organelles).<ul style="list-style-type: none"><li>▪ 1.2a - Important levels of organization for structure and function include organelles, cells, tissues, organs, organ systems, and whole organisms.</li><li>▪ 1.2f - Cells have particular structures that perform specific jobs. These structures perform the actual work of the cell. Just as systems are coordinated and work together, cell parts must also be coordinated and</li></ul></li></ul></li></ul>		



<p>work together.</p> <ul style="list-style-type: none"> <li>▪ 1.2i - Inside the cell a variety of specialized structures, formed from many different molecules, carry out the transport of materials (cytoplasm), extraction of energy from nutrients (mitochondria), protein building (ribosomes), waste disposal (cell membrane), storage (vacuole), and information storage (nucleus).</li> </ul> <ul style="list-style-type: none"> <li>• Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.             <ul style="list-style-type: none"> <li>○ P.I. 5.1: Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.                 <ul style="list-style-type: none"> <li>▪ 5.1c - In all organisms, organic compounds can be used to assemble other molecules such as proteins, DNA, starch, and fats. The chemical energy stored in bonds can be used as a source of energy for life processes.</li> <li>▪ 5.1d - In all organisms, the energy stored in organic molecules may be released during cellular respiration. This energy is temporarily stored in ATP molecules. In many organisms, the process of cellular respiration is concluded in mitochondria, in which ATP is produced more efficiently, oxygen is used, and carbon dioxide and water are released as wastes.</li> <li>▪ 5.1e - The energy from ATP is used by the organism to obtain, transform, and transport materials, and to eliminate wastes.</li> </ul> </li> </ul> </li> </ul>	
<p><b>Objectives:</b></p> <ol style="list-style-type: none"> <li>1. Students will understand that yeast are single celled organisms with mitochondria which allow them to undergo cellular respiration.</li> <li>2. Students will understand that, besides ATP, respiration also results in CO<sub>2</sub> gas.</li> <li>3. Students will understand that some sort of sugar is required for respiration, and that some sugar sources work better than others.</li> <li>4. Students will understand that in a yeast solution, the formation of gas is a sign that respiration is taking place.</li> </ol>	
<p><b>Materials:</b></p> <ol style="list-style-type: none"> <li>1. Yeast Investigation Packet (attached)</li> <li>2. Sweetener Research Sheet(attached)</li> <li>3. Bottles(Plastic water bottles work)</li> <li>4. Balloons that can fit over the rim of the bottles</li> <li>5. Funnels</li> <li>6. Dry baker's yeast</li> <li>7. Table sugar</li> <li>8. Glucose solution</li> <li>9. Fructose solution</li> <li>10. Stevia sweetener</li> <li>11. Peer assessment for class presentation (attached)</li> <li>12. Peer Evaluation Form (attached)</li> <li>13. Group Processing Questions (attached)</li> </ol>	
<p><b>Scaffold Suggestions:</b></p> <ul style="list-style-type: none"> <li>• Group strong science students with students who struggle with science.</li> <li>• Give assistance to any students who are struggling during the activity.</li> </ul>	
<b>Procedure:</b>	<b>Cooperative Components:</b>

<p><b>Day 1 – (~40 minutes)</b></p> <p><u><b>Anticipatory Set: (~10 minutes)</b></u></p> <ul style="list-style-type: none"> <li>• Have a bottle, balloon, funnel, yeast and sugar ready for a demonstration in front of the class.</li> <li>• When class starts, put a tablespoon of yeast and a tablespoon of sugar in the bottle.</li> <li>• Fill the bottle half way up, and cap it with a balloon.</li> <li>• Discuss with the class why the balloon would blow up.</li> <li>• Lead the students to the conclusion that the yeast cells are undergoing respiration and giving up carbon dioxide gas.</li> </ul> <p><u><b>Body: (20 – 30 minutes)</b></u></p> <ul style="list-style-type: none"> <li>• Split the class into groups of three.</li> <li>• Hand out a ‘Yeast Investigation’ packet and a ‘Sweetener Research’ sheet to each student.</li> <li>• Lead the class through the first part of the packet explaining the situation of getting bread dough to rise higher.</li> <li>• Discuss with the whole class how yeast makes dough rise, and what it needs to work referring to the demonstration at the beginning of class.</li> <li>• Next each student has to pick a sweetener to research for their group. Each group member should have a different sweetener to research. <b>A-3, B-1, C-1</b></li> <li>• Students must research their assigned sweetener, and come back to the next class with their research sheets filled out. <b>A-3, B-1, C-1</b></li> </ul> <p><b>Day 2 – (60 – 80 minutes)</b></p> <ul style="list-style-type: none"> <li>• Quickly check that each student filled out their research sheets.</li> <li>• Make sure each group shares their research. Then each group needs to decide which sweetener they will experiment with. <b>A-3, B-1, C-1</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Positive Interdependence</b> <ul style="list-style-type: none"> <li>○ A-2: Each member of a group will be given bonus points towards their next exam if all group member score 90% or better on their lab packets. So students have to depend on their group members to do well along with themselves.</li> <li>○ A-3: Each member of the group has to research a different sweetener. So students have to depend on each other to figure out the best sweetener to use.</li> </ul> </li> <li>• <b>Promotive Interaction</b> <ul style="list-style-type: none"> <li>○ B-1: Positive interdependence is established with <b>A-2</b> and <b>A-3</b>. Since students are dependent on each other to do well, they should be motivated to encourage each other.</li> <li>○ B-3: Group processing will give students an opportunity to reflect on how encouraging they and their group members were during this activity.</li> </ul> </li> <li>• <b>Individual Accountability</b> <ul style="list-style-type: none"> <li>○ C-1: Each group member is given their own unique assignment when they each have to research a different sweetener. This puts pressure on each individual to do their fair share of the work.</li> <li>○ C-4: Group processing will take place on the last day. Students can think about how much work they and their peers contributed to the group success. This will cause them to think about what they can do to be better contributors next time.</li> </ul> </li> <li>• <b>Interpersonal Skills</b> <ul style="list-style-type: none"> <li>○ D-2: When students have to decide on a sweetener to use, and when they have to design</li> </ul> </li> </ul>
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<ul style="list-style-type: none"> <li>• This is a good opportunity to observe different groups and see how they cooperate to come up with a decision. <ul style="list-style-type: none"> <li>○ Look for examples of good interpersonal skills and poor interpersonal skills that can be shared with the class. <b>D-2</b></li> </ul> </li> <li>• Once a group decides on a sweetener, they must describe on their packets their experimental set up. <ul style="list-style-type: none"> <li>○ This is another good time to look for examples of good and poor interpersonal to share with the whole class. <b>D-2</b></li> </ul> </li> <li>• Have each group show you their experimental set up before beginning.</li> <li>• Once they are approved by the teacher, each group can get their supplies and run their experiments.</li> <li>• Once experiments are done, students need to clean everything, and figure out what their results are and what that means.</li> <li>• Each group must be ready to presents their experiments to the rest of the students on the next day of class.</li> </ul> <p><b>Day 3 – (60 – 80 minutes depending on how many groups need to present)</b></p> <ul style="list-style-type: none"> <li>• Hand out a ‘presentation peer assessment’ rubric to each student.</li> <li>• Start the presentations. They should be about 5 minutes each.</li> <li>• When presentations are over, collect the rubrics from each student.</li> <li>• Have the groups finish the packets.</li> <li>• Let students know that a packet will be collect from each individual. <ul style="list-style-type: none"> <li>○ If each student from a group scores 90% or better on their packet, then every student in the group will get 5 bonus points on their next class exam.</li> </ul> </li> </ul> <p><b>A-2, B-1</b></p> <p><u>Closure:</u> <b>B-3, C-4, D-3, E-1</b></p> <ul style="list-style-type: none"> <li>• Reserve 10 – 20 minutes for group</li> </ul>	<p>their experiments, they have to use their interpersonal skills. The teacher can look for opportunities to explain to the class what people do to communicate well, and the wrong ways to communicate.</p> <ul style="list-style-type: none"> <li>○ D-3: There will be time for group processing on the last day. This will allow to reflect on their interpersonal skills. They can discuss how they did and how their peers did. Then they can consciously think about how to improve for future cooperative activities.</li> </ul> <ul style="list-style-type: none"> <li>• Group Processing <ul style="list-style-type: none"> <li>○ E-1: 10 -20 minutes are reserved for group processing. This will contribute to improvement in cooperative activities for each student.</li> <li>○ E-2: The ‘group processing questions’ will guide students through a discussion of when went well, what went poorly, and what should be changed for next time.</li> <li>○ E-3: The ‘peer evaluation forms’ will reinforce the group processing activity as it will get students to think about how they and their peers did during the activity. Then they can go into a discussion ready to contribute.</li> </ul> </li> </ul>
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<p>processing based on the entire 3 day activity.</p> <ul style="list-style-type: none"> <li>○ Hand out ‘peer evaluation forms’ to each student along with the ‘group processing questions’ to each group. <b>E-3</b></li> <li>○ Have students do their best to complete the evaluation forms. Then have the groups discuss with each other to come up with thoughtful answers for the ‘group processing questions’. <b>E-2</b></li> </ul>	
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>• Assess the answers and experimental set ups on each student’s packet.</li> <li>• Observe student presentations and look over presentation peer assessment rubrics.</li> <li>• Look over the ‘peer evaluation forms’ to see how well students did in cooperative groups.</li> <li>• Look over the ‘group processing questions’ to see if the students are trying to improve their cooperative learning skills.</li> </ul>	

## Lesson 7 Attachments

### Student Handout 1

NAME: \_\_\_\_\_

#### **Yeast Investigation**

Problem: Ms. Jones has asked for your help. She has to bake the largest loaf of bread to win the competition at the fair. Since you are the yeast experts, she has asked you to come up with a yeast recipe that will raise the dough as much as possible.

How does yeast make dough rise?

What does it need to work?

Table sugar(sucrose) is usually added to yeast to help it work. You have three different sweeteners other than sugar to work with. You need to find out which one is the most effective for fermentation. Every group must do a set-up with sucrose to have a control for comparison. Each group can pick one additional sweetener to use in a second set up to compare with the control.

#### **Sweeteners**

##### **Control:**

Sucrose(table sugar): This is made up of disaccharide molecules each consisting of one glucose bonded to one fructose. This is an easily digested molecule.

##### **Experimental Options:**

1. Fructose(Fruit sugar): This is made up of simple monosaccharides. It binds with glucose to form one molecule of sucrose. It is easy to digest.
2. Glucose(Blood sugar): This is made up of simple monosaccharides. This is the molecule that gets used for both anaerobic and aerobic respiration.
3. Stevia: This is the leaf of a subtropical plant that tastes very sweet. It has no calories, so people like to use it in place of sugar.

**Which of these three sweeteners will mix with yeast to create the most CO<sub>2</sub> ?**

Predict which sweetener will result in the most CO<sub>2</sub>.

- Each group member needs to pick one of the experimental sweeteners to research.
- Each group member must take a 'sweetener research' sheet home.
- Before next class, each group member must look online to fill out the 'sweetener research' sheet so that the group will have a 'sweetener research' sheet for each sweetener next class.
- All group members must read each other's research and discuss which sweetener they should use.

After following the above steps, which sweetener did you decide to test?

Explain why you chose that sweetener.

Your materials:

-bottles, balloons, funnels, yeast, sucrose and one of 3 other sweeteners.

Set up a procedure for how you will test the sweetener. You should come up with a way to compare it with sucrose.

Describe your procedure below step by step. Use pictures if you want.

Results:

What happened? Did your sweetener result in a bigger balloon than sucrose? How do you know?

Conclusions:

What do your results mean? Does your sweetener give off more CO<sub>2</sub> gas than sucrose?

Prepare to explain your experiment to the whole class. Be sure to...

- explain why you picked your sweetener
- describe your experimental set up and why you did it that way
- explain your results being sure to point out if your sweetener would result in bigger loaf of bread or not

After Presentations:

Did other groups try other sweeteners? What did they find out?

Did other groups use the same sweetener? If so, did they come to the same conclusion as you?

Further thoughts:

What could you have done better in your procedure? What went wrong?

What are some further questions or problems you could investigate with cellular respiration besides sweeteners?



**Lesson 7: Student Handout 2 – To be Handed out on Day 1.**

Name: \_\_\_\_\_

**Sweetener Research**

1. Which sweetener are you researching?
2. Write down basic information about your sweetener.
3. What are some reasons this sweetener may result in a bigger loaf of bread?
4. What are some reasons this sweetener may result in a small loaf of bread?

## Lesson 7: Student Handout 3 – For Presentations

### Peer Assessment for Presentations

	Very Good 3	Satisfactory 2	Poor 1
Reasons for picking sweetener make sense.			
Procedure is clearly expressed.			
The results make sense.			
Overall, how did the group do?			
Total = /12			

## Lesson 7: Student Handout 4 – For Group Processing

### Peer Evaluation Form

Name \_\_\_\_\_

Group Member Names:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Directions: Use this form to rate yourself and your group members using the number scale. Add up the points at the bottom to get each total.

Ratings: 5=Perfect 4=very good 3=good enough 2=could be better 1=very poor

Attribute	You	Member 1	Member 2	Member 3
Contributed to the activity.				
Encouraged others.				
Carried out role responsibilities				
Communication Skills				
Professionalism				
TOTALS				

## Lesson 7: Student Handout 5 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

## Lesson 8 – Natural and Sexual Selection

### Significance of Lesson

The interplay between natural and sexual selection is a difficult concept for students to grasp. This simulation is a great way to show the interplay in action. However, without cooperative learning, it would be extremely difficult to ensure that each student understands what they are looking for and what to conclude.

This lesson shows how cooperative learning can help students to gain understanding of a complicated concept. When students work interdependently in groups, at least one member is likely to understand what is going on, and the student will be motivated to help his/her group mates. Individually, each student is motivated to understand the investigation and what it means as they will each have to present what they did to large groups.

<b>Grade:</b> High School/ 9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> Day 1 - 80 minutes/ Day 2 – 60 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• Students should possess a 7<sup>th</sup> grade minimum reading level.</li><li>• Students should possess basic inter-personal skills.</li><li>• Students should have successfully completed a life science course in middle school.</li><li>• Students should be introduced to evolution. They should have some knowledge of Natural selection and the mechanisms of evolution.</li><li>• Students may or may not understand sexual selection.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>• Standard 4</li><li>• Key Idea 3: Individual organisms and species change over time.<ul style="list-style-type: none"><li>○ P.I. 3.1: Explain the mechanisms and patterns of evolution.<ul style="list-style-type: none"><li>▪ 3.1 e - Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life-forms, as well as for the molecular and structural similarities observed among the diverse</li></ul></li></ul></li></ul>		

<p>species of living organisms.</p> <ul style="list-style-type: none"> <li>▪ 3.1 f - Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.</li> <li>▪ 3.1 g - Some characteristics give individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce. The proportion of individuals that have advantageous characteristics will increase.</li> </ul>	
<p><b>Objectives:</b></p> <ol style="list-style-type: none"> <li>1. Students will understand that natural selection is not the only driving force for evolution.</li> <li>2. Students will understand the role that sexual selection plays in evolution.</li> </ol>	
<p><b>Materials:</b></p> <ol style="list-style-type: none"> <li>1. <a href="#">Flashy Fish Simulation</a> (2001)</li> <li>2. Flashy Fish Investigation packet (attached)</li> <li>3. Peer Presentation Assessment (attached)</li> <li>4. Group Processing Checklist (attached)</li> <li>5. Group Processing Questions(attached)</li> </ol>	
<p><b>Scaffold Suggestions:</b></p> <ul style="list-style-type: none"> <li>• Print out descriptions for each role which can be provided for students to make their responsibilities more clear to them.</li> <li>• Group students together that can help each other. For instance, a student who struggles with the concept of evolution could be put in the same group with a student who shows deep understanding of evolution.</li> </ul>	
<p><b>Procedure:</b></p> <p>Day 1 – (80 minutes)</p> <p><u>Anticipatory Set:</u></p> <ul style="list-style-type: none"> <li>• Ask students what they know about natural selection and discuss it with them.</li> <li>• Ask students if anything else can drive evolution. See what they think, but don't talk about sexual selection yet.</li> <li>• Explain to the class that John Endler was a researcher who found something interesting when he studied fish in Trinidad. Many male guppies were brightly colored.</li> <li>• Why would guppies evolve to be so brightly colored if it makes them stand out to predators?</li> </ul>	<p><b>Cooperative Components:</b></p> <ul style="list-style-type: none"> <li>• Positive Interdependence <ul style="list-style-type: none"> <li>○ A-1: Each student is given a well defined role for this activity. This gives them each a responsibility that they must fulfill for group success.</li> <li>○ A-4: Each student in each group must represent their groups in the large groups. This creates dependence among students in the small groups as they have to count on each group member, in addition to</li> </ul> </li> </ul>

<ul style="list-style-type: none"> <li>• Explain to the students that they are going to do some research to answer the above question.</li> </ul> <p><u>Body:</u></p> <ul style="list-style-type: none"> <li>• Split the class into groups of three, and assign roles. <ul style="list-style-type: none"> <li>○ Roles are as follows:<b>A-1, B-1, C-1</b> <ul style="list-style-type: none"> <li>▪ Decision maker – this student makes the final decision after a discussion. For example, after students discuss which hypothesis makes the most sense, the decision maker will have the final say in which one the group chooses. The decision maker is especially important when all students in the group cannot come to the same conclusion.</li> <li>▪ Recorder – this student is responsible for filling out the activity packet on behalf of the whole group.</li> <li>▪ Ambassador – this student is responsible for making sure everyone in the group is contributing to the activity, and that they are all respectful towards one another. He/she should encourage other students. If there is a problem related to student cooperation or participation, the ambassador must inform the teacher. <b>B-2, C-2, D-1</b></li> </ul> </li> <li>○ All students are responsible for contributing to the activity as much as possible.</li> </ul> </li> <li>• Hand out one ‘Flashy Fish Investigation’ packet to each group.</li> <li>• Make sure each group has access to at least one computer.</li> <li>• Each group must read through the steps, and work together to understand the directions, and conduct research using the computer simulation.</li> <li>• As students work together in their groups,</li> </ul>	<p>themselves, to do their best on the presentations.</p> <ul style="list-style-type: none"> <li>• Promotive Interaction <ul style="list-style-type: none"> <li>○ B-1: Positive interdependence should be effectively established with the group roles (<b>A-1</b>) and the jigsaw activity (<b>A-4</b>). Therefore, students should be motivated to encourage each other.</li> <li>○ B-2: The ‘ambassador’ role is given so that at least one student in each group will be thinking about encouraging others. This could also remind the other two students to be encouraging as well.</li> <li>○ B-3: Group processing will take place at the end of the activity on day 2. This will allow students to think about if they were encouraging enough, and if there is a way to improve for next time.</li> </ul> </li> <li>• Individual Accountability <ul style="list-style-type: none"> <li>○ C-1: Each member of the group is assigned a role for this activity. This means each member has their own unique responsibilities. So, if a student doesn’t do their job, it will be easy to notice.</li> <li>○ C-2: Part of the ‘ambassador’s’ job is to make sure everyone in the group is doing their fair share. This will help the teacher a lot as it can be very difficult to keep track of every student in every group.</li> <li>○ C-3: The jigsaw</li> </ul> </li> </ul>
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<p>observe certain groups to find examples of very good interpersonal skills or very poor interpersonal skills. If appropriate, share these examples with the whole class as a way to teach students about interpersonal skills. <b>D-2</b></p> <ul style="list-style-type: none"> <li>• When students are done with the investigation, explain that they will have to give a presentation of what they did to their peers during next class. <b>A-4, B-1, C-3</b> <ul style="list-style-type: none"> <li>○ The class will be split up into 3 new large groups consisting of all ambassadors, all decision makers and all recorders.</li> <li>○ In each large group, each student will explain to the group what their small group did and what conclusions they came up with.</li> <li>○ Each student will given a peer assessment sheet for each student they observe in the large groups.</li> <li>○ Students grades for the presentations will be based on an average of the peer assessments for all 3 small group members.</li> <li>○ Make sure students understand that every member of the small group has to be prepared to present the investigation well for the group to get a good grade.</li> <li>○ With this in mind, make sure groups work together to prepare for the large group presentations.</li> <li>○ If there is any time left in the period, let students use it to prepare for their large group presentations.</li> </ul> </li> </ul> <p><b>Day 2 – (60 minutes)</b></p> <ul style="list-style-type: none"> <li>• Set up the large groups, provide enough peer assessment sheets for each student, then have students start presenting the investigations to each other. When they are finished, collect all of the peer assessment sheets.</li> <li>• Now have the small groups get back together.</li> </ul> <p><u>Closure:</u></p>	<p>presentation activity (<b>A-4</b>) will put pressure on each individual student to do their best for the success of the group.</p> <ul style="list-style-type: none"> <li>○ C-4: Group processing will take place at the end of the whole activity on the second day. This will give the group members a chance to reflect on how much they and their peers contributed to the success of the group. They can also look for ways to be better contributors next time.</li> </ul> <ul style="list-style-type: none"> <li>• Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-1: One responsibility of the ‘ambassador’ is to make sure each group member is communicating in a professional and positive way. If any issues between students arise, the ‘ambassador’ is supposed to alert the teacher. This makes it easier for the teacher to keep track of how students are doing during the activity.</li> <li>○ D-2: As students work together on the ‘Flashy Fish’ simulation, the teacher can look for examples of high quality and low quality interpersonal skills. Pointing out an example, good or bad, in front of the class, is a good way to teach students how to communicate and interact with each other.</li> <li>○ D-3: The group processing at the end of this activity</li> </ul> </li> </ul>
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<ul style="list-style-type: none"> <li>• Save at least 10 minutes for group processing. <b>B-3, C-4, D-3, E-1</b></li> <li>• Hand out the ‘group processing checklist’ forms to each students first. <b>E-2, E-3</b></li> <li>• Students should fill out the forms individually or with their group members. <b>E-2, E-3</b></li> <li>• Next, hand out one ‘group processing questions’ sheet to each group. <b>E-2</b></li> <li>• Group members should work together to answer questions as thoughtfully as possible. <b>E-2</b></li> </ul>	<p>will give students and opportunity to reflect on how they communicated and interacted with each other. They can discuss what they did well and what they did not so well, and come up with ways to improve for next time.</p> <ul style="list-style-type: none"> <li>• Group Processing <ul style="list-style-type: none"> <li>○ E-1: At least 10 minutes will be reserved at the end of the whole activity on day 2. This will cause students to look at their mistakes and achievements in cooperative learning rather than forget about them. By participating in group processing, students will most likely show improvement on their next cooperative learning activity.</li> <li>○ E-2: The ‘group processing’ questions and the last 2 questions on the ‘group self evaluation checklist’ will guide students into thinking and discussing what went well, what went poorly and how they can improve next time.</li> <li>○ E-3: The ‘group processing checklist’ is a quick way to get students reflecting about how they and their group did on the activity. It will prepare them for a thoughtful discussion with the ‘group processing questions’.</li> </ul> </li> </ul>
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>• Periodically observe groups, and see how they are understanding the activity.</li> <li>• Observe as many presentations as you can to get an idea of how students grasped the</li> </ul>	

concepts.

- Assess the lab packets to see how students understood the activity.
- Look over the 'peer presentation assessments' to get an idea of how well each student represented their group.
- Read each 'group processing check list' and each set of 'group processing questions' to get an idea of how each student did with cooperative learning.

## Lesson 8 Attachments

### Student Handout 1

Name:

#### Flashy Fish Investigation

You and your partners are going to study fish using a computer simulation.

Procedure:

Step 1 – Get on a computer and go to this site:

<http://www.pbs.org/wgbh/evolution/educators/lessons/lesson4/act2.html>

Step 2 – Read the introduction, then click the link to launch the ‘Sex and the Single Guppy’ simulation.

Step 3 – Read through the introduction and examine the 3 different pools.

Step 4 – Click on the ‘What causes guppy color variation’ link, and choose one of the three hypotheses. You can make up your own hypothesis if you want.

Hypothesis:

Step 5 – Now set up a simulation and fill in the chart below. You have to choose guppy colors and predator number and species. You also need to decide how many weeks to run the simulation. Run three trials.

Guppy Colors			
Predators			
<b>Results after _____ weeks</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>
Total Guppies			
Percent Brightest			
Percent Bright			
Percent Drab			
Percent Drabbest			

What do your results mean? Do they support your hypothesis or refute it?

Step 6 – If you decide to change your hypothesis, write your new hypothesis here.

New Hypothesis:

Step 7 – Run another simulation changing either guppy color or predators.

Guppy Colors			
Predators			
<b>Results after _____ weeks</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>
Total Guppies			
Percent Brightest			
Percent Bright			
Percent Drab			
Percent Drabbest			

What do your results mean? Do they support your hypothesis or refute it?

Step 8 - If you decide to change your hypothesis this time, write it below.  
New Hypothesis:

Step 9 – Run one more set of simulations changing either guppy color or predators.

Guppy Colors			
Predators			
<b>Results after _____ weeks</b>	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>
Total Guppies			
Percent Brightest			
Percent Bright			
Percent Drab			
Percent Drabbest			

What is your final conclusion?

Explain what you know about sexual selection.

How does sexual selection play a role in the evolution of a species?

What are some things you could have done differently in this investigation?

What are some further questions you have? What is some further research you could do?

## Lesson 8: Student Handout 2 – For Presentations

### Peer Presentation Assessment

	Very Good 3	Satisfactory 2	Poor 1
Procedure is clearly expressed.			
The results make sense.			
Overall, how did the group do?			
Total =           /9			

## Lesson 8: Student Handout 3 – For Group Processing

### Group Processing Checklist

Name \_\_\_\_\_

Group Member Names \_\_\_\_\_

With your group members, decide which accomplishments you achieved and check yes or no accordingly. Also, complete the two statements at the bottom.

<b>Accomplishments</b>	<b>Yes</b>	<b>No</b>
We completed our task successfully.		
We were encouraging to each other.		
We were respectful towards each other.		
We all worked hard to complete the assignment		
Our biggest strength was...		
We all could work on improving...		

## Lesson 8: Student Handout 4 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?



## Lesson 9 – Build a Phylogenetic Tree

### Significance of Lesson

Here is a very appropriate lesson for evolution. It gives students a way to map out and visualize evolution. This can make concepts in evolution much more clear for students.

However, this is not a skill that each student can easily learn. By using cooperative learning, all students are more likely to learn this skill than without it.

The cooperative components ensure that each student will learn this skill. Students in each group become interdependent as well as individually accountable as they each have to complete a tree for a unique set of organisms. With a positive reward interdependence, students will be motivated to help their group members do the tree right as well as themselves. With these components in place, each student should be confident in making their own phylogenetic trees.

<b>Grade:</b> High School/ 9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> 80 minutes
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• Students should possess a 7<sup>th</sup> grade minimum reading level.</li><li>• Students should possess basic inter-personal skills.</li><li>• Students should have successfully completed a life science course in middle school.</li><li>• Students should be introduced to evolution. They should have some knowledge of Natural selection and the mechanisms of evolution.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>• Standard 4</li><li>• Key Idea 3: Individual organisms and species change over time.<ul style="list-style-type: none"><li>○ P.I. 3.1: Explain the mechanisms and patterns of evolution.<ul style="list-style-type: none"><li>▪ 3.1 a - The basic theory of biological evolution states that the Earth's present-day species developed from earlier, distinctly different species.</li><li>▪ 3.1 e - Natural selection and its evolutionary consequences provide a</li></ul></li></ul></li></ul>		

<p>scientific explanation for the fossil record of ancient life-forms, as well as for the molecular and structural similarities observed among the diverse species of living organisms.</p> <ul style="list-style-type: none"> <li>3.1 j - Billions of years ago, life on Earth is thought by many scientists to have begun as simple, single-celled organisms. About a billion years ago, increasingly complex multicellular organisms began to evolve.</li> <li>3.1 k - Evolution does not necessitate long-term progress in some set direction. Evolutionary changes appear to be like the growth of a bush: Some branches survive from the beginning with little or no change, many die out altogether, and others branch repeatedly, sometimes giving rise to more complex organisms.</li> </ul>	
<b>Objectives:</b>	
<b>Materials:</b> <ol style="list-style-type: none"> <li><a href="#">Build A Phylogenetic Tree Instructional Packet</a> (Grajkowski, 2011)</li> <li>White construction paper, glue and black markers.</li> <li>Phylogenetic Tree Questions</li> <li>Peer Evaluation Form(attached)</li> <li>Group Processing Questions(attached)</li> </ol>	
<b>Scaffold Suggestions:</b> <ul style="list-style-type: none"> <li>Group students together that can help each other. For instance, a student who struggles with the concept of evolution could be put in the same group with a student who shows deep understanding of evolution.</li> </ul>	
<b>Procedure:</b>  <u>Anticipatory Set:(5 – 10 minutes)</u> <ul style="list-style-type: none"> <li>Draw a smiley face on the board with just two dot eyes and a smile mouth.</li> <li>Draw another smiley face like the first, but with a nose.</li> <li>Draw a third smiley face like the first but with ears.</li> <li>Draw a fourth smiley face like the second, but with hair.</li> <li>Draw a fifth smiley face like the third but with sunglasses.</li> <li>Now show the student how these five smiley faces can be grouped into a phylogenetic tree as if they were organisms in Nature.</li> </ul>	<b>Cooperative Components:</b> <ul style="list-style-type: none"> <li>Positive Interdependence <ul style="list-style-type: none"> <li>A-2: Students will be encouraged to help each other do well on the ‘Phylogenetic Tree Questions’ since there is a reward if they all score over 90%. By helping their peers, they will be helping themselves.</li> <li>A-4: By giving each group member a different part of the activity, it gives them each a shared responsibility for the group grade. This will motivate them to do their best while also helping and receiving help from their peers.</li> </ul> </li> </ul>

<ul style="list-style-type: none"> <li>• In this way the students can see the basics of making a phylogenetic tree.</li> </ul> <p><b><u>Body:</u> (50 – 60 minutes)</b></p> <ul style="list-style-type: none"> <li>• Provide each student with a copy of pages 1-4 of the ‘Building a Phylogenetic Tree’ packet.</li> <li>• Split students into groups of three. <ul style="list-style-type: none"> <li>○ One student from each group must be provided with a copy of page 6 from the ‘Building a Phylogenetic Tree’ packet. <b>C-1</b></li> <li>○ A second student from each group must be provided with a copy of page 7 from the ‘Building a Phylogenetic Tree’ packet. <b>C-1</b></li> <li>○ A third student from each group must be provided with a copy of page 8 from the ‘Building a Phylogenetic Tree’ packet. <b>C-1</b></li> </ul> </li> <li>• Instruct the students to work together in their groups to understand how to build a phylogenetic tree with pages 1-4.</li> <li>• This would be a good time to observe different groups to see how they are doing with their interpersonal skills. Examples of really good communication or really poor can shared with the whole class to teach them about how to communicate and how not to communicate. <b>D-2</b></li> <li>• Each member needs to fill out the chart on page 2 using their unique set of organisms (page 6, 7 or 8). <b>C-1</b></li> <li>• When students finish their charts, they need to construct their phylogenetic trees. <ul style="list-style-type: none"> <li>○ Make sure they each have construction paper so they can cut out all 6 of their organisms and glue them on in the right arrangement.</li> <li>○ Each student should use page 4 and the assistance of their</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Promotive Interaction <ul style="list-style-type: none"> <li>○ B-1: The positive interdependence established through the shared responsibilities in this activity should motivate students to encourage one another.</li> <li>○ B-3: Group processing will take place after the activity. This will give students a chance to think about how they interacted with their group members. They and their group members can decide if they were encouraging enough to each other. They can also reflect on ways to improve for future cooperative learning activities.</li> </ul> </li> <li>• Individual Accountability <ul style="list-style-type: none"> <li>○ C-1: By giving each group member a different part of the activity, they each receive a unique responsibility. This will put pressure on each individual to do their best so they don’t let the group down.</li> <li>○ C-3: A-4 is achieved by making each student’s assessment part of the group grade. This will reinforce each individual’s effort for group success.</li> <li>○ C-4: There will be time set aside after the activity for group processing. This will give students a chance to think about and discuss how much contribution each individual made. They can then discuss ways to improve their individual contributions during future cooperative learning activities.</li> </ul> </li> <li>• Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-2: When students are working together to understand the directions for building a phylogenetic tree, they will have</li> </ul> </li> </ul>
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<p>group members to draw out their ‘trees’ with a black marker on the construction paper connecting the glued on organisms.</p> <ul style="list-style-type: none"> <li>• Let students know that each group member’s chart and tree will be individually graded, and each grade will be added to form one group grade given to all group members. <b>A-4, B-1, C-3</b></li> <li>• Once the ‘trees’ are completed, hand out the ‘Phylogenetic Tree Questions’.</li> <li>• Instruct each student to individually complete the questions.</li> <li>• If each group member scores 90% or better on their questions, then all group members will receive 5 extra credit points on this activity or on their next exam. <b>A-2, B-1</b></li> <li>• The questions can be completed for homework if time runs out.</li> </ul> <p><b><u>Closure:</u> (10 – 15 minutes) B-3, C-4, D-3</b></p> <ul style="list-style-type: none"> <li>• Save at least 10 minutes for group processing</li> <li>• Hand out the “Peer Evaluation” forms to each student and have them complete the forms in their groups.</li> <li>• Next, hand out the “Group Processing Questions” (one sheet per group) and instruct the students to work with their group members to answer the questions as thoughtfully as possible.</li> </ul>	<p>to communicate well. This is a good time for the teacher to observe groups and find examples of effective and ineffective interactions between students that are worth sharing with the class. In this way the teacher can show students how to interact and how not to interact during collaborative activities.</p> <ul style="list-style-type: none"> <li>○ D-3: Group processing should take place at the end of this activity. This will be an opportunity for group members to give each other feedback on their interpersonal skills so they can figure out where they need to improve for next time.</li> </ul> <ul style="list-style-type: none"> <li>• <b>Group Processing</b> <ul style="list-style-type: none"> <li>○ E-1: At least 10 minutes will be reserved at the end of this activity for students to reflect upon their cooperative abilities. This will allow students to figure out their strengths and weaknesses. As students participate in future cooperative activities, they will improve.</li> <li>○ E-2: The “group processing questions” will guide students through a discussion about what they did well, what they did not so well, and how they can improve for next time.</li> <li>○ E-3: The ‘peer evaluations’ will reinforce the group processing by prompting students to think about how they did in certain areas during the group activity. They should be completed before the “group processing questions”.</li> </ul> </li> </ul>
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>• Periodically observe groups, and see how they are understanding the activity.</li> <li>• Assess the phylogenetic trees to see if the students understood how to build one.</li> </ul>	

- Assess the 'phylogenetic tree questions' to see how well students understand phylogeny.
- Read each 'group self evaluation check list' and each set of 'group processing questions' to get an idea of how each student did with cooperative learning.

## Lesson 9 Attachments

### Student Handout 1

NAME:

#### **Phylogenetic Tree Questions**

1. Explain some of the relationships on your phylogenetic tree. Which organisms are the most closely related and which are the least?
2. Do the relationships(described in question 1) make sense? How do you know?
3. Based on your phylogenetic tree, explain how your organisms evolved.
4. You may have similar traits that evolved at two different times. These are called convergent characteristics. Can you identify any convergent characteristics in your group of organisms using your 'tree'? If so, explain the characteristic and the two places it evolved.

## Lesson 9: Student Handout 2 – For Group Processing

### Peer Evaluation Form

Name \_\_\_\_\_

Group Member Names:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

Directions: Use this form to rate yourself and your group members using the number scale. Add up the points at the bottom to get each total.

Ratings: 5=Perfect 4=very good 3=good enough 2=could be better 1=very poor

Attribute	You	Member 1	Member 2	Member 3
Contributed to the activity.				
Encouraged others.				
Carried out role responsibilities				
Communication Skills				
Professionalism				
TOTALS				

## Lesson 9: Student Handout 3 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?



## Lesson 10 – Human Impact Project

### Significance of Lesson

When it comes to human impact, there are many topics that can be discussed. This activity allows students to become exposed to many of the different topics. Cooperative learning will ensure that students get the most out of these exposures.

The cooperative components motivate students to support each other while also giving students individual responsibilities. Each student must research their own subtopic within the group topic. Then, since they all have to present the group topics, students are likely to learn about the other subtopics in their group. Finally, students will have to assess the presentations of the other groups which will make it likely that they learn something about the other group topics.

<b>Grade:</b> High School/ 9 <sup>th</sup> and 10 <sup>th</sup> grade	<b>Subject:</b> NYS Living Environment	<b>Duration:</b> Four 80 minute periods
<b>Knowledge and Skill Prerequisites:</b> <ul style="list-style-type: none"><li>• Students should possess a 7<sup>th</sup> grade minimum reading level.</li><li>• Students should possess basic interpersonal skills.</li><li>• Student should have successfully completed a life science course in middle school.</li><li>• Students should be comfortable navigating the internet for information.</li></ul>		
<b>State Standards:</b> <ul style="list-style-type: none"><li>• Standard 4</li><li>• Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.<ul style="list-style-type: none"><li>○ P.I. 7.1: Describe the range of interrelationships of humans with the living and nonliving environment.<ul style="list-style-type: none"><li>▪ 7.1 a - The Earth has finite resources; increasing human consumption of resources places stress on the natural processes that renew some resources</li></ul></li></ul></li></ul>		

and deplete those resources that cannot be renewed.

- 7.1 b - Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental.
- 7.1 c - Human beings are part of the Earth's ecosystems. Human activities can, deliberately or inadvertently, alter the equilibrium in ecosystems. Humans modify ecosystems as a result of population growth, consumption, and technology. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems may be irreversibly affected.
- P.I. 7.2: Explain the impact of technological development and growth in the human population on the living and nonliving environment.
  - 7.2 a - Human activities that degrade ecosystems result in a loss of diversity of the living and nonliving environment. For example, the influence of humans on other organisms occurs through land use and pollution. Land use decreases the space and resources available to other species, and pollution changes the chemical composition of air, soil, and water.
  - 7.2 b - When humans alter ecosystems either by adding or removing specific organisms, serious consequences may result. For example, planting large expanses of one crop reduces the biodiversity of the area.
  - 7.2 c - Industrialization brings an increased demand for and use of energy and other resources including fossil and nuclear fuels. This usage can have positive and negative effects on humans and ecosystems.
- P.I. 7.3: Explain how individual choices and societal actions can contribute to improving the environment.
  - 7.3 a – Societies must decide on proposals which involve the introduction of new technologies. Individuals need to make decisions which will assess risks, costs, benefits, and trade-offs.
  - 7.3 b - The decisions of one generation both provide and limit the range of possibilities open to the next generation.

**Objectives:**

1. Students will acquire information on a few aspects of the human impact on nature.
2. Students will be exposed to many different aspects of the human impact on nature.
3. Students will improve their collaboration skills.
4. Students will improve their presentation skills.

**Materials:**

1. List of topics and subtopics (attached).
2. Computers with internet access.
3. Computer projector (for groups that present a PowerPoint)

4. Poster paper and markers/colored pencils(for groups that make a poster for presentation)
5. Presentation Rubric (attached)
6. Cooperative Learning Rubric (attached)
7. Group Processing Questions (attached)

### **Scaffold Suggestions:**

- Print out descriptions for each role which can be provided for students to make their responsibilities more clear to them.
- Group students together that can help each other. For instance, a student who struggles with the research or presentations can be in a group with students who do well at research and presentations.

### **Procedure:**

#### **Day 1 – (80 minutes)**

##### Anticipatory Set:

- Start the class with two questions:
  - How much of an impact do humans have on the world?
  - What are some specific ways humans can effect the environment?
- Discuss these questions with the class for about 5 minutes.

##### Body:

- Explain the activity
  - Students will be organized into groups of 4
  - Each group will pick a human impact topic from the list on a handout.
    - Each group has to have a different topic.
  - Each member of the group must pick one subtopic to research. **A-3, B-1, C-1**
  - Each member of the group will be responsible to research online or in their textbooks to answer the questions that go along with their subtopics.
    - For each subtopic, students must write out(handwritten or typed) the answers to their questions along with the

### **Cooperative Components:**

- Positive Interdependence
  - A-1: Once students start planning their presentations, they are assigned roles. The roles give each student a unique responsibility. This makes group success dependent on each student doing their part.
  - A-3: Each student in the group has their own sub topic to complete. This causes each student to depend on their peers for group success. If one member doesn't do their research, the group will be held back.
  - A-4: By averaging the grades of each group member's subtopic submission, each member will have a contribution towards the group grade. This way, students will depend on each other to do their best when researching and addressing the questions for their subtopics.
- Promotive Interaction
  - B-1: Positive interdependence is promoted in three different ways

<p>sources they used.</p> <ul style="list-style-type: none"> <li>○ Based on the information each group member found for their subtopics, the group members will put together a presentation on their whole topic. <ul style="list-style-type: none"> <li>▪ The presentation should be a collaboration among the group.</li> <li>▪ There should be a visual- i.e.: poster, PowerPoint or handout</li> <li>▪ All subtopic question should be addressed.</li> <li>▪ Presentation must get information across, but keep to the point.</li> <li>▪ Minimum of 10 minutes and maximum of 20 minutes.</li> </ul> </li> <li>• Split the students into groups of 4.</li> <li>• Give each group a copy of the topics, and have them each pick a different topic. <ul style="list-style-type: none"> <li>○ 2 groups can have the same topic only if there are more than 6 groups.</li> </ul> </li> <li>• Once each group has a topic, each member must pick a subtopic to research. <b>A-3, B-1, C-1</b></li> <li>• Students in each group will have to express themselves well as they decide what topic and subtopic they each want. They may have to make compromises. This will be a good time for the teacher to observe different groups to look for examples of high quality or poor quality interpersonal skills. The teacher can share these examples with the class to show students effective communication versus ineffective communication. <b>D-2</b></li> <li>• Once each student has a subtopic, give them the rest of the period to research their subtopic questions.</li> <li>• Assign each student to bring in a sheet with all their subtopic questions answered as completely as possible along</li> </ul>	<p>throughout this project. When students have to depend on their peers to do well, they should be motivated to encourage each other to do their best.</p> <ul style="list-style-type: none"> <li>○ B-2: An ambassador is assigned for each group because one of his/her responsibilities is to encourage the rest of the group to do well. This should help to spread promotive interaction amongst the other group members.</li> <li>○ B-3: Group processing will take place on the last day once the presentations are over. This will give students a chance to reflect on their performances, and think about how encouraging they and their peers were. They can then think about ways to be more encouraging next time.</li> <li>• Individual Accountability <ul style="list-style-type: none"> <li>○ C-1: Each student is given their own subtopic to research at the beginning of the project. Each subtopic is different, so students are on their own to complete their part. If students don't complete their assignments, they will hinder the whole group.</li> <li>○ C-1: Students are assigned roles when they start planning their presentations. This gives each student unique responsibilities which make them more likely to contribute to the group .</li> <li>○ C-2: The ambassador role is assigned in each group so that one student can focus on making sure every other</li> </ul> </li> </ul>
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<p>with the sources they used. <b>A-3, B-1, C-1</b></p> <ul style="list-style-type: none"> <li>○ Make sure students know that their submissions will be graded, and that the average of all group members' individual submissions will be the grade given to each group member for this part. <b>A-4, B-1, C-3</b></li> <li>○ They must have two copies: one to hand into the teacher and another to use when putting the presentation together.</li> </ul> <p><b>Day 2 – (80 minutes)</b></p> <ul style="list-style-type: none"> <li>● Collect students' answers to their questions.</li> <li>● Assign roles to each group member. <b>A-1, B-1, C-1</b></li> <li>● Roles are as follows: <ul style="list-style-type: none"> <li>○ Decision maker – this student makes the final decision after a discussion. For example, if everyone in the group cannot agree on using a PowerPoint or a poster, the decision maker must make the final decision. This student will be especially important when the group needs to hurry and move on with the project.</li> <li>○ Ambassador – this student is responsible for making sure everyone in the group is contributing to the activity, as well as making sure they are all respectful to each other. He/she should also encourage other students. If there is a problem related to student cooperation or participation, the ambassador must inform the teacher. <b>B-2, C-2, D-1</b></li> <li>○ Recorder – this student is responsible for taking notes and writing out a script or outline of the presentation.</li> <li>○ Visual Coordinator – This student</li> </ul> </li> </ul>	<p>student is involved and contributing. This should help to ensure that every student does their fair share.</p> <ul style="list-style-type: none"> <li>○ C-3: <b>A-4</b> is accomplished by having the group grade depend on each individual grade for the first part of the project. This will put pressure on each individual student to do his/her best for the group.</li> <li>○ C-4: There will be at least 20 minutes of time for group processing after the presentations. This will give students a chance to think about how much they and their peers contributed to the project. They can also figure out ways to be better contributors during future cooperative activities.</li> </ul> <ul style="list-style-type: none"> <li>● Interpersonal Skills <ul style="list-style-type: none"> <li>○ D-1: An ambassador role is assigned in each group. One of the responsibilities of the ambassador is to make sure students are communicating efficiently and respectfully. If there is a conflict between students in the group, the ambassador needs to report it to the teacher. This will help to ensure that students are using effective interpersonal skills. It is also a way for the teacher to become aware of issues that he/she doesn't see right away.</li> <li>○ D-2: There are two specific periods during the activity when the teacher should observe the interpersonal skill of students. This provides opportunities for the teacher to teach the class about proper</li> </ul> </li> </ul>
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<p>is responsible for putting together the visual based on how the group wants it to be.</p> <ul style="list-style-type: none"> <li>• Once the roles are assigned, give the students the rest of the period to plan out the presentation.</li> <li>• Give students a copy of the rubric so they know how they're being graded.</li> <li>• Let students know that the presentation grade for the whole group will be based on the teacher's assessment averaged with the peer assessments.</li> <li>• As students work together to plan out the presentations they will have to communicate well and come to agreements in a professional manner. This would be a good time for the teacher to observe different groups and look for examples of high quality and low quality interpersonal skills. The examples can be shared with the class to demonstrate how interaction between collaborators should and should not be. <b>D-2</b></li> <li>• Presentations must be ready for next class.</li> <li>• Let students know that</li> </ul> <p><b>Day 3– (80 minutes)</b></p> <ul style="list-style-type: none"> <li>• Hand out several rubrics to each student so they can turn in an assessment of each of the other groups.</li> <li>• Decide the order of presentations then, when everyone is ready, start the presentations.</li> <li>• Do your own assessment of each presentation with the rubric.</li> <li>• Fit as many presentations in as time allows.</li> <li>• Groups that are not able to present today can do their presentations during the next class.</li> </ul> <p><b>Day 4 – (80 minutes)</b></p> <ul style="list-style-type: none"> <li>• Finish presentations.</li> </ul> <p><u>Closure:</u></p> <ul style="list-style-type: none"> <li>• Make sure there are at least 20 minutes left for group processing. <b>B-3, C-4, D-3,</b></li> </ul>	<p>interpersonal skills.</p> <ul style="list-style-type: none"> <li>○ D-3: There will be at least 20 minutes of time reserved after the presentations for group processing. This will give students a chance to think about how they and their peers performed as communicators. They can also think of ways to be better communicators during future collaborative activities.</li> </ul> <ul style="list-style-type: none"> <li>• Group Processing <ul style="list-style-type: none"> <li>○ E-1: A minimum of 20 minutes will be provided for group processing after the presentations. There is enough time and effort put into this project that students should have more time than usual for group processing.</li> <li>○ E-2: The 'Group Processing Questions' will guide students through a discussion of what went well, what went poorly, and what they could do differently next time to improve.</li> <li>○ E-3: The 'Cooperative Learning Rubrics' will allow student to thoroughly assess how their peers did during the activity. It will prompt students to think about things they can discuss with the group when answering the 'Group Processing Questions'.</li> </ul> </li> </ul>
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<p><b>E-1</b></p> <ul style="list-style-type: none"> <li>○ Hand out three copies of the ‘Cooperative Learning Rubric’ to each student and give them time to fill one out for each of the peers in their group. <b>E-3</b></li> <li>○ Hand out one copy of the ‘Group Processing Questions’ to each group and give them the rest of the time to discuss and thoughtfully address each question. <b>E-2</b></li> </ul>	
<p><b>Assessment:</b></p> <ul style="list-style-type: none"> <li>● Periodically check in with students during the activities to observe how they’re doing.</li> <li>● Assess the answers to subtopic questions which each student hands in to see the quality of their information and understanding.</li> <li>● Use the ‘Presentation Rubrics’ to assess student presentations, and look over peer assessments of presentations as well.</li> <li>● Look over the ‘Cooperative Learning Rubrics’ to get an idea of how well students collaborated.</li> <li>● Read through the ‘Group Processing Questions’ to get an idea of how well students collaborated, and also to see how much thought students put into their performance.</li> </ul>	

## Lesson 10 Attachments

**Student Handout 1 – Each group should have at least one to look over.**

### **Human Impact Topics**

- 1) Habitat Destruction
  - a) Deforestation
    - i) Why do people cut down forests?
    - ii) How are animals affected?
    - iii) How do people try to recover the forests?
    - iv) What is the difference between old growth and secondary growth? What is the difference between clear cutting and selective tree farming?
  - b) Soil Conservation
    - i) What are the components of good soil?
    - ii) Describe the types of soil conservation practices
    - iii) How can soil be compromised/leaching?
    - iv) How do dams help soil conservation?
  - c) Strip Mining
    - i) What is strip mining?
    - ii) What are some adverse effects of strip mining?
    - iii) What is coal used for and how is it formed?
    - iv) What other materials can be used instead of coal?
  - d) Algae Bloom
    - i) What are fertilizers used for?
    - ii) What is an algae bloom?
    - iii) What causes an algae bloom?
    - iv) How are plants and animals affected?
- 2) Air Pollution
  - a) Automobiles
    - i) How do automobiles add to air pollution?
    - ii) Why is air pollution harmful?
    - iii) What is being done about emission controls?
    - iv) What are some alternatives to decrease the problem?
  - b) Ozone
    - i) What is the ozone and what is its function?
    - ii) What causes the hole in the ozone?
    - iii) How does the hole affect us?
    - iv) What can be done to stop the increase in the hole?
  - c) Smog
    - i) What is smog and where can it be found?
    - ii) What is a temperature inversion?
    - iii) How does rain "clean" air?
    - iv) Compare today's smog with the past. (chart)
  - d) Leaf blowers
    - i) Why are leaf blowers bad for the environment?



- ii) What is being done about them?
  - iii) What is asthma?
  - iv) How are asthma sufferers affected by leaf blowers?
- 3) Environmental Poisons
  - a) Lead
    - i) Where does lead come from? (products)
    - ii) Why was it added to products?
    - iii) What are the effects of lead on living things?
    - iv) What are some legislation that have been proposed/passed to regulate lead?
  - b) Mercury
    - i) Where does mercury come from? (products)
    - ii) Why was it added to products?
    - iii) What are the effects of mercury on living things?
    - iv) What are some legislation that have been proposed/passed to regulate mercury?
  - c) Radon
    - i) Where does radon come from? (products)
    - ii) Why was it added to products?
    - iii) What are the effects of radon on living things?
    - iv) What are some legislation that have been proposed/passed to regulate radon?
  - d) Methyl Tertiary-Butyl Ether (MTBE)
    - i) Where does MTBE come from? (products)
    - ii) Why was it added to products?
    - iii) What are the effects of MTBE on living things?
    - iv) What are some legislation that have been proposed/passed to regulate MTBE?
  - e) PCBs
    - i) What are PCBs?
    - ii) Why were they used?
    - iii) What are the effects of PCBs on living things?
    - iv) Describe recent events involving PCBs, the Hudson River, and legislation involving the cleanup.
- 4) Animal Rights
  - a) Animal Testing
    - i) What are some of the products that rely on animal testing?
    - ii) Why are animals used for testing?
    - iii) What are some of the ethical issues involving animal testing?
    - iv) What are some of the laws designed to protect animals in research?
  - b) Zoo Animals
    - i) What are some of the benefits for keeping animals in captivity?
    - ii) What are some of the health/species issues associated with animals in captivity?
    - iii) What are some of the ways that zoos have tried to alleviate these problems?
    - iv) What are some of the laws involving the protection of animals in zoos?
  - c) Hunting/Poaching
    - i) What is poaching?
    - ii) What are some of the reasons that people hunt for sport and/or poach?
    - iii) What are the effects of hunting on the ecosystem (both positive and negative)?
    - iv) What are some of the laws involving the protection of endangered species?

- d) Imported Species
  - i) Why do people import non-native species?
  - ii) What is the impact of imported species on the native ecosystem? Give examples.
  - iii) What are some of the laws involving the importing of non-native species?
- 5) Exploitation of Natural Resources
  - a) Recycling
    - i) What materials can be recycled?
    - ii) How does recycling help the environment?
    - iii) How do recycling plants work? Give examples.
    - iv) What happens to the recycled paper here at school?
    - v) What are some products that are made from recycled material?
  - b) Burning of Fossil Fuels
    - i) What are fossil fuels?
    - ii) How were they formed? Why are they considered "nonrenewable"?
    - iii) What is the effect of burning fossil fuels on living things?
    - iv) What are some legislation passed to regulate fossil fuels?
  - c) Alternate Renewable Energy
    - i) Why do we need alternate renewable energy sources?
    - ii) Where are some renewable energy sources found?
    - iii) How do these sources lead to the production of energy?
    - iv) What are the impacts of alternate fuels on the environment?
  - d) Thermal Pollution
    - i) What is thermal pollution?
    - ii) Where does thermal pollution come from?
    - iii) What is the impact of thermal pollution on the environment?
    - iv) What are some possible solutions to the problem of thermal pollution?
- 6) Biodiversity
  - a) Pesticides
    - i) What are pesticides?
    - ii) What are the 4 different kinds of pesticides?
    - iii) Which pesticides are best for the environment?
    - iv) What are some recent legislation involving pesticides?
  - b) DDT
    - i) What is DDT?
    - ii) How is DDT used?
    - iii) What are the negative effects of DDT?
    - iv) What happened to the California Condor because of DDT?
  - c) Biodiversity
    - i) What is biodiversity?
    - ii) Why is biodiversity important?
    - iii) How are humans affecting biodiversity?
    - iv) What is being done to protect biodiversity?
  - d) Extinction / Endangered Species
    - i) What is an endangered species? What happens when a species becomes extinct?
    - ii) What are some causes of extinction?
    - iii) How have humans affected the rates of extinction of species? Give examples.

- iv) How does the extinction of a species affect the ecosystem?
- v) What is being done to protect endangered species?

## Lesson 10: Student Handout 2 – For Presentations

### Human Impact Presentation Rubric

	Excellent 4	Good 3	Fair 2	Poor 1	Missing 0
Information	Group presented the information very clearly. It was very understandable	The information was mostly understandable	Some of the information did not make sense	Very little of the information made sense	There was no clear information presented
Effort	The group went above and beyond to make the presentation the best it could be down to the last detail	The group fulfilled every requirement of the presentation.	The group fulfilled most of the requirements of the presentation.	The group left out a lot of the requirements for the presentation.	Nothing was completed for the presentation.
Creativity/Originality	Presentation was very unique overall. It really stands out.	There was many unique aspects in the presentation	There were some unique aspects in the presentation	There was one unique aspect in the presentation	There was nothing unique about the presentation
Visual	Power point, poster or handout was very clear. It was also aesthetically pleasing.	Visual was clear and easy to understand	Visual was mostly understandable	Most of the visual was unclear	There was no visual
Total (out of 16)	Additional Comments:				

## Lesson 10: Student Handout 3 – For Group Processing

### Cooperative Learning Rubric

Name: \_\_\_\_\_

Name of group member being assessed: \_\_\_\_\_

Category	4	3	2	1
<b>Contribution to the Task</b>	Went above and beyond. Not only completed his/her own part, but helped each other group member complete theirs.	Did his/her fair share of the task. Also provided some assistance to other group members.	Did less than his/her fair share of the task. Did not provide any assistance to the other group members.	Did almost nothing towards the completion of the task. Provided no assistance to the rest of the group.
<b>Promoting the Group</b>	Was always very encouraging. Displayed a very positive attitude, and helped motivate the other group members.	Was encouraging most of the time. Had a positive attitude most of the time.	Provided a little encouragement. Did not usually have a positive attitude.	Had a negative attitude most of the time. Provided no encouragement
<b>Inter-personal Skills</b>	Communicated very well. Was very easy to understand. Always respectful to other students.	Was understandable most of the time. Was respectful to other students most of the time.	Was understandable sometimes. Was respectful to other students sometimes.	Did not communicate or was not understandable. Was not respectful to others.
<b>Role Responsibilities</b>	Completely fulfilled his/her role responsibilities. Helped other students to carry out their roles.	Fulfilled most of his/her role responsibilities.	Fulfilled some of his/her role responsibilities.	Did not fulfill his/her role responsibilities.
<b>TOTAL SCORE:</b>  _____	Comments:			

## Lesson 10: Student Handout 4 – For Group Processing

Names:

**Group Processing Questions:** Think about how well your group worked together today. Discuss these questions with each other, and answer them as best as you can.

1. What are three things your group did that contributed to completing the activity?
2. What are three things your group did that did not contribute to completing the activity?
3. Next time, what things will you continue to do as a group, and what will you stop doing?

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